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Effects of meteorological factors on hospital admissions and outcomes of patients with acute coronary syndromes

Meteorolojik etkenlerin akut koroner sendromlu hastaların hastaneye başvuru ve sonuçlarına etkileri

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Abstract

Aim. Global warming is affecting the entire Earth, and the temperatures will continue to rise. We aimed to provide data about admissions to a coronary care unit and its relation to temperature and climatic data that will probably change in nature in the following decades. **Methods.** The study group comprised 289 consecutive patients with acute coronary syndrome admitted to the coronary care unit of Uludağ University Hospital in Bursa between 1 July 2006 and 31 June 2007. We retrospectively analyzed the data of patients and gathered the climate data from the Department of Meteorology of the Republic of Turkey Ministry of Environment and Forestry, for the city of Bursa (40°11′N, 29°04′E). **Results.** The mean age of the 289 cases was 60.5 ± 12.3. Among the study group, 224 cases were male (77.5%). Hyperlipidemia was present in 80 patients (27.7%). Among the patients 120 (41.5%) cases had hypertension, and 64 (22.1%) cases had type 2 diabetes mellitus. The number of admissions tended to decrease with increasing mean daily temperature. Seasonal variations including temperature, humidity and pressure did not significantly affect the outcome of inpatients. **Conclusions.** In this study, we did not find any association between the outcome and seasonal distribution in the admission of acute coronary patients. The number of admissions increases in the cold season. Only presence of anemia and obesity appeared to affect the outcome of patients.

Keywords: Acute coronary syndrome, seasons, meteorological factors

Özet

Amaç. Küresel ısınma tüm yerküreyi etkilemektedir ve sıcaklıklar artmaya devam edecektir. Bu çalışmada koroner yoğun bakım ünitesine yatışlar ve muhtemelen önümüzdeki yıllar içinde doğasında değişiklik olacak olan sıcaklık ve iklimsel veriler ile ilişkisi incelendi. **Yöntem.** Çalışma grubu Uludağ Üniversitesi Hastanesi Koroner Bakım Ünitesine akut koroner sendrom ile 1 Temmuz 2006 ile 31 Haziran 2007 tarihleri arasında başvuran 289 hastadan oluşturuldu. Geriye dönük olarak hastaların verileri analiz edildi ve Çevre ve Orman Bakanlığı Meteoroloji dairesinden Bursa için (40°11dk Kuzey, 29°04dk Doğu) meteorolojik verileri alındı. **Bulgular.** Çalışma grubundaki 289 hastanın yaş ortalaması 60,5 ± 12,3 idi ve 224'ü (%77,5) erkekti. Seksen (27,7%) hastada hiperlipidemi mevcuttu . Yüz yirmi (41,5%) hastada hipertansiyon, 64 (22,1%) hastada tip 2 diabetes mellitus vardı. Artan sıcaklıklar ile hastaneye başvuru sayısında azalmaya eğilim vardı. Mevsimsel ve sıcaklık, nem ve basınç gibi iklimsel değişiklikler hastane içi sonuçları etkilemedi. **Sonuçlar.** Bu çalışmada hastaneye başvuran akut koroner sendrom hastalarında hastane içi sonuçlar ve ve mevsimsel dağılım arasında ilişki bulunamadı. Soğuk mevsimde hastaneye yatışlar daha fazlaydı. Yalnızca anemi ve obezite varlığı hasta sonuçlarını etkilemiştir.

Anahtar sözcükler: Akut koroner sendrom, mevsimler, iklimsel etkenler

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Introduction

In 1937, Masters et al. [1] have described an increase in mortality from acute myocardial infarction in winter seasons. Since then larger studies have confirmed these findings [2, 3]. Hernández et al. [4] on behalf of the PRIMVAC study research team have reported the presence of a seasonal pattern in the admissions for acute myocardial infarction in the cardiology intensive care units of the Community of Valencia Spain, with an increase in the number of cases in winter and a decrease in summer. In that report, age of patients have been shown to influence the effect of environmental factors on acute ischemic heart disease, especially in cases over 65 years of age. In Turkey the climate is 'Mediterranean' with wet, mild winters and long, hot, dry summers particularly in the Marmara and Aegean and the Mediterranean region. We do not have much data on the effect of weather on cardiovascular diseases. Global warming is affecting the Earth [5]. This probably will cause climate change in many parts of the world including the Anatolia. In this study, we aimed to compare the discharge status of patients in terms of temperature and climatic data that will probably change in nature in the following decades.

Materials and Methods

The study group comprised 289 consecutive patients with acute coronary syndrome admitted to the coronary care unit of Uludağ University Hospital in Bursa Turkey between 1 July 2006 and 31 June 2007. We retrospectively analyzed the data of patients, and gathered the climate data from the Department of Meteorology of the Republic of Turkey Ministry of Environment and Forestry, for the city of Bursa (40°11′N, 29°04′E). We gathered the data of biochemical markers, serum enzyme levels, serum lipid levels, and prior history of cardiac disease, coronary risk factors and the outcome of the patients. We calculated the frequencies of the cases according to months, seasons and seasonal variations. Aeroset kits (Abbott Diagnostic Division; Abbott Laboratories, USA) were used for creatinine kinase-MB (CKMB) and the Immulite 2000 cTnI sandwich assay (Siemens Healthcare Diagnostics, Los Angeles, USA) was used for the determination of troponin I levels.

At the admission and during the coronary care unit stay, in all patients, troponin and CKMB levels were measured at least once a day. Anemia was defined as a hemoglobin level of 12.1 g/dL for women and 13.1 for men according to the definition of World Health Organization [6]. Patients were identified as hypertensive on the basis of clinical history or if they required antihypertensive therapy. Diabetes mellitus was defined by history of the diagnosis or by regular use of insulin or oral hypoglycemic agents. BMI was calculated as weight in kilograms divided by height in meters squared. For adults, overweight was defined as ≥BMI 25 kg/m^2 and obesity was defined as ≥30.0 kg/m^2 [7]. Family history of premature CAD mortality was defined as death due to CAD, myocardial infarction, or sudden death (defined as death associated with an unexplained and sudden collapse) before 55 years of age (for men) and 65 years of age (for women) in any first-degree relative or grandparents. The mean±SD was calculated for each variable. The data were analyzed with SPSS v10.0 (SPSS Inc., Chicago, IL, USA). Chi-square test was used for comparisons. A P-value <0.05 was considered to be statistically significant.

Results

The mean age of the 289 cases involved was 60.5±12.3. The average temperatures for Bursa in 2007 were given in Figure 1. The monthly distribution of the cases was given in

Figure 2. Among the study group, 224 cases were male (77.5%). The troponin levels were positive in 189 cases (65.4%). Hyperlipidemia was present in 80 patients (27.7%). Among the patients 120 (41.5%) cases had hypertension, and 64 (22.1%) cases had type 2 diabetes mellitus. Family history of coronary heart disease was positive in 13 cases (4.5%). Among the study group 29 patients (%10) were obese. The mean values of hemogram and serum lipid profiles of the cases were presented in Table 1.

Table 1. Serum lipid parameters and the hemograms of the patients.

	Blood Levels
Total Cholesterol (mg/dl)	189.2±48.8
LDL-Cholesterol (mg/dl)	116.4±40.5
HDL-Cholesterol (mg/dl)	43.7±12.1
Triglyceride (mg/dl)	158.5±117.8
Hemoglobin (g/dl)	13.5±2.7
Hematocrit (%)	40.0±5.8
Platelet count(mm3)	253000.0±85258.5

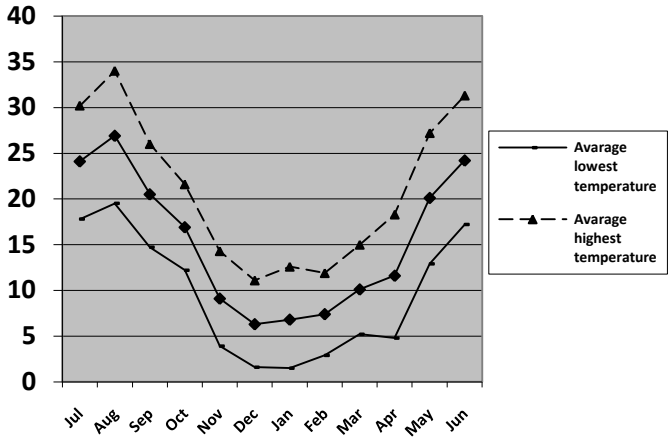

Figure 1. The temperature values for Bursa from 1 July 2006 to 31 June 2007.

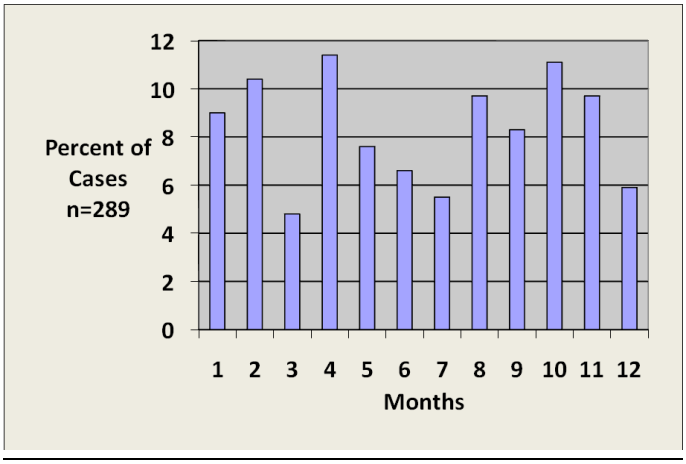

Figure 2. Monthly distribution of the total patient admission.

When the outcomes of patients (discharged or died) were compared; having elevated serum CKMB and troponin levels, being obese and having anemia were significantly more prevalent in the patients that had mortality (Table 2).

Table 2. Effects of patient charactheristics on in-hospital outcome

	Discharged		Exitus		Total
	n	%	n	%	
Gender (χ^2=1.9, p>0.05)					
Male	211	78.4	13	65	224 (77%)
Female	58	21.6	7	35	65 (33%)
Age Distribution (χ^2=7.5, p>0.05)					
<40	14	5.2	1	5.0	15 (5%)
40-49	35	13.0	1	5.0	36 (12%)
50-59	80	29.7	4	20.0	84 (29%)
60-69	75	27.9	8	40.0	83 (29%)
70-79	47	17.5	2	10.0	49 (17%)
80+	18	6.7	4	20.0	22 (8%)
Presence of Anemia (χ^2=7.4, p<0.05)					
Present	71	26.4	11	55	82 (28%)
Absent	198	73.6	9	45	207 (72%)
Type 2 Diabetes Mellitus (χ^2=0.8, p>0.05)					
Present	58	21.6	6	30.0	64 (22%)
Absent	211	78.4	14	70.0	225 (88%)
Hypertension (χ^2=0.02, p>0.05)					
Present	112	41.6	8	40.0	120 (41%)
Absent	157	58.4	12	60.0	169 (59%)
Hyperlipidemia (χ^2=0.06, p>0.05)					
Present	74	27.5	6	30.0	80 (28%)
Absent	195	72.5	14	70.0	209 (72%)
Smoking (χ^2=0.2, p>0.05)					
Present	66	24.5	4	20.0	70 (24%)
Absent	203	75.5	16	80.0	219 (76%)
Obesity (χ^2=14.8, p<0.05)					
Present	22	8.2	7	35.0	29 (10%)
Absent	247	91.8	13	65.0	260 (90%)
Troponin Levels (χ^2=9.1, p<0.05)					
High	74	27.5	10	50.0	84
Normal	99	36.8	1	5.0	100
CKMB Levels (χ^2=9.2, p<0.05)					
High	66	22.3	9	45.0	69
Normal	113	42.0	2	10.0	115

Comparison of the cases according to history, clinical characteristics, clinical risk factors, serum biochemical examinations in relation to discharged or died during the in-hospital period were given in Table 2. The patient distribution of the cases according to seasonal variations and hot and cold periods of the year and their association with the in-hospital outcome are given in Table 3. The meteorological variations including temperature, humidity and pressure did not significantly affect the in-hospital outcome of the patients (Table 4).

Table 3. Distribution of patient admissions according to season and hot and cold periods

	Discharged (n)	%	Mortality (n)	%	Total
(χ^2=0.28, p>0.05)					
Oct 01-Mar 31	124	46.1	8	40	132 (%45)
Apr 01- Sep 30	145	53.9	12	60	157 (%55)
(χ^2=2.59, p>0.05)					
Spring	67	24.9	2	10	69 (%24)
Summer	57	21.2	6	30	63 (%21)
Autumn	78	29	6	30	84 (%30)
Winter	67	24.9	6	30	73 (%25)

The cases admitted to the Emergency Clinic at temperatures below 10 degree Celsius regardless of the season have constituted 39 percent of total cases. The number of admissions tended to decrease with increasing mean daily temperature.

Table 4. Distribution of admissions according to meteorological data

	Discharged		Exitus		Total
	n	%	n	%	
Humidity (%) (χ^2=1.8, p>0.05)					
22(min)-40	11	4.1	-	-	11 (3%)
40-60	65	24.2	7	35.0	72 (25%)
60-80	139	51.7	9	45.0	148 (52%)
80-94 (max)	54	20.1	4	20.0	58 (20%)
Temperature °C (χ^2=3.01, p>0.05)					
<10,0	103	38.3	10	50.0	113 (39%)
10,1-20,0	91	33.8	3	15.0	94 (33%)
20,1+	75	27.9	7	35.0	82 (28%)
Pressure milibar (χ^2=4.8, p>0.05)					
987-1000	66	24.5	3	15.0	69 (24%)
1001-1010	153	56.9	10	50.0	163 (57%)
1010-1020	37	13.8	4	20.0	41 (14%)
1035 (max)	13	4.8	3	15.0	16 (5%)

The distribution of the cases according to humidity values are given in Figure 3. The percent of cases according to daily temperature are given in Figure 4.

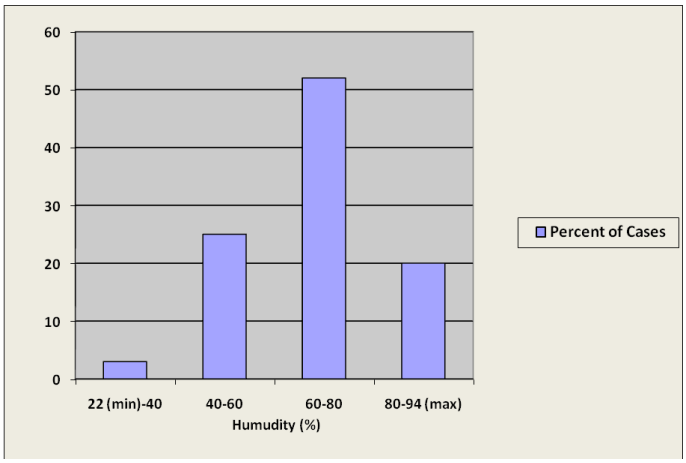

Figure 3. Distribution of the cases according to humidity values.

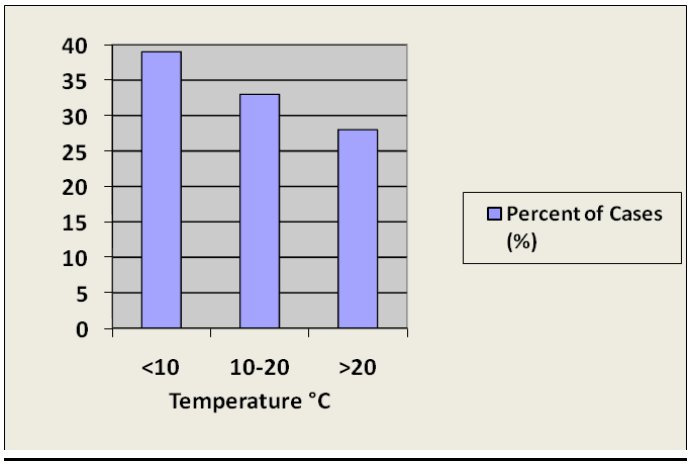

Figure 4. Distribution of the cases according to temperature

Discussion

The study group comprised of acute coronary syndrome patients admitted to coronary care unit. Our finding that admissions were more frequent with decreasing temperature is in accordance with the findings of Panagiotakos et al. [8] Seasonal changes have been shown in the pattern of cardiac deaths in New South Wales and Western Sydney Area Health Service by Weerasinghe et al. [9]. They found that there were higher death ratios from cardiac events during the winter months, particularly in July. Fifty five percent of the cases have been admitted in autumn and winter in that study. The death rates however did not show seasonal variation like our cases. In a study that has examined temperature and cardiovascular deaths, mortality increased with deviations from seasonally determined thermally neutral conditions. Snowfall during the previous day also increased the mortality [10]. We did not notice any effect of seasons on the mortality of acute coronary syndrome patients. Auliciems et al. [11] have analyzed mortality rates for a decade in Brisbane for dependence upon atmospheric factors. They have showed that deaths were observed to increase with colder and less humid weather. Also in Auckland, New Zealand daily myocardial infarct deaths showed an increase in mortality rate with decreasing temperatures over the entire thermal range [12]. Colder weather has been shown to alter hemodynamic and hematological factors in favor of arterial thrombosis [13].

The coronary artery disease has classical risk factors. The acute coronary syndromes are believed to have triggers like heavy exercise, cold weather, mental stress, and sexual activity, exposures to cocaine, marijuana, and particulate air pollution [14]. There are also some studies that suggested an increase in cardiac events during the summer [15]. Angina pectoris, silent myocardial ischemia, acute myocardial infarction, and sudden cardiac death typically increase in frequency between 6 AM and noon [16, 17]. Seasonal changes in hemodynamics might contribute to seasonal variation in acute myocardial infarction. For example, Argiles et al. [18] recently reported that blood pressure was higher during the winter compared with summer months in patients with end-stage renal disease. The reason for the number of admissions because of having acute coronary syndrome being high in cold days may be caused be the increased cardiac workload during the winter, higher coronary and vascular resistance induced by cold, higher blood pressure during the winter, and higher fibrinogen levels reported in winter. These all may account for the increased rate of admission.

It may be wise to advice coronary patients to avoid environmental stresses, especially extreme cold and hot weathers. The average temperatures will probably raise and the tendency to have more admissions for acute coronary syndromes in cold weathers may change to some extend by involving very hot summer days. Acclimatized buildings and vehicles must be obligatory to avoid very young, elderly and people with illness.

This study had limitations that may be attributed to being retrospective. However the data

gathered may provide suitable environment for future comparisons of the globally warmed earth with current conditions. In this study we did not find any association between inpatient outcome and seasonal distribution in the admission of acute coronary patients. The number of admissions increases in the cold season. The presence of anemia and obesity affects the outcome of patients.

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