MCBU SBED
MANİSA CELAL BAYAR ÜNİVERSİTESİ SAĞLIK BİLİMLERİ ENSTİTÜSÜ DERGİSİ
MANISA CELAL BAYAR UNIVERSITY JOURNAL OF INSTITUTE OF HEALTH SCIENCE
ISSN: 2147-9607

ARAŞTIRMA MAKALESİ
RESEARCH ARTICLE
CBU-SBED, 2025, 12 (4): 494-498

The effect of Meteorological Factors on Myocardial Infarction with ST Segment Elevation, A Single Center Experience

Meteorolojik Faktörlerin ST Segment Yükselmeli Miyokard Enfarktüsü Üzerine Etkisi, Tek Merkez Deneyimi

Mümin Murat Yazıcı[1], Gürkan Altuntaş[1], Nurullah Parça[1], Özlem Bilir[1]

[1]Recep Tayyip Erdoğan University Training and Research Hospital, Department of Emergency Medicine, Rize,

e-mail: mmuratyazici53@gmail.com, gurkan_altuntas@hotmail.com , nrllhprca@gmail.com , drozlembilir@gmail.com
ORCID: 0000-0003-1957-7283
ORCID: 0000-0001-7390-2513
ORCID: 0009-0002-2492-3128
ORCID: 0000-0001-9016-1665

*Sorumlu Yazar / Corresponding Author: Mümin Murat Yazıcı
Gönderim Tarihi / Received:14.012.2025
Kabul Tarihi / Accepted: 12.02.2025
DOI: 10.34087/cbusbed.1619589

Öz

Giriş ve Amaç: Bazı meteorolojik faktörler ile akut koroner sendrom (AKS) arasında ilişki olabileceğini düşündüren çalışmalar olmasına rağmen, meteorolojik faktörler ile AKS alt grupları arasındaki ilişkiyi değerlendiren yeterli sayıda çalışma bulunmamaktadır. Bu çalışmada, meteorolojik faktörlerin acil servise başvuran ST segment yükselmeli miyokard enfarktüsü (STEMI) sayısı üzerindeki etkisini değerlendirmeyi amaçladık.

Gereç ve Yöntemler: Bu tek merkezli, retrospektif çalışmada, acil servise başvuran ve sonrasında STEMI ve NSTEMI tanısı alan ve koroner yoğun bakım ünitesine kabul edilen hastalar incelendi. Veri analizinden önce etik kurul onayı alınmıştır (karar no. 2022/154). Meteorolojik faktörlerin STEMI üzerindeki etkileri Poisson regresyon analizi yöntemleri kullanılarak hesaplanmıştır.

Bulgular: STEMI başvuru sayısını etkileyen meteorolojik faktörler Poisson dağılımına göre analiz edildiğinde, meteorolojik faktörler arasında sıcaklığın STEMI başvuru sayısını etkilediği görülmüştür. Sıcaklıktaki 1^0C'lik artış STEMI başvuru sayısında %5'lik bir artışa neden olmuştur (Odds Oranı: 1,05, %95 Güven Aralığı: 1,001 - 1,110, p=0,036).

Sonuç: Bu çalışma, STEMI başvurularının yüksek sıcaklıkla birlikte arttığını göstermektedir. Bu doğrultuda sıcak havalarda artacak STEMI vakalarına hızlı ve etkin erişim için hastane öncesi sistemin buna göre düzenlenmesi düşünülebilir.

Anahtar kelimeler: ST Yükselmeli Miyokard Enfarktüsü (STEMI), Meteorolojik Faktörler, Koroner Arter Hastalığı

Abstract

Aim; Although there are studies suggesting that there may be a relationship between some meteorological factors and acute coronary syndrome, there are not enough studies evaluating the relationship between meteorological factors and acute coronary syndrome subgroups. In this study, we aimed to evaluate the effect of meteorological factors on the number of ST-segment elevation myocardial infarction admitted to the emergency department.

Method; In this single-center, retrospective study, we examined patients who presented to the emergency department and were subsequently diagnosed with ST segment elevation myocardial infarction and non-ST segment elevation myocardial infarction and admitted to the coronary intensive care unit. The ethics committee's

approval was obtained before data analysis (decision no. 2022/154). We calculated the effects of meteorological factors on the incidence of ST segment elevation myocardial infarction using Poisson regression analysis methods.
Results; When the meteorological factors affecting number of ST segment elevation myocardial infarction admissions were analyzed according to the Poisson distribution, it was seen that temperature among the meteorological factors affected number of ST segment elevation myocardial infarction admissions. A 1 ^{0}C increase in temperature caused a 5% increase in ST segment elevation myocardial infarction admissions (Odds Ratio: 1.05, 95% Confidence Interval: 1.001 - 1.110, p=0.036).
Conclusion; This study shows that ST segment elevation myocardial infarction admissions increase with high temperature. In this direction, it may be considered to organise the pre-hospital system accordingly for fast and effective access to ST segment elevation myocardial infarction cases that will increase in hot weather.

Keywords: Coronary Artery Disease, Meteorological Factors, ST Elevation Myocardial Infarction (STEMI)

1. Introduction

Four major noncommunicable diseases caused approximately 33.3 million deaths in 2019 (Uncertainty interval (UI): 24.5-43.3 million) deaths in 2019, an increase of 28 per cent compared to 2000. Cardiovascular diseases (17.9 million, UI: 13.4-22.9 million) are the leading cause of these deaths [1]. Similarly, according to the Turkish Statistical Institute, diseases of the circulatory system were the major reason for death in 2022, accounting for 35.4% of all deaths. Moreover, 42.3% of these circulatory system disease deaths were caused by coronary artery disease (CAD) [2].

There are many risk factors for CAD, including hypertension, diabetes, smoking, diet, and obesity [3]. It is also known that weather and climate changes may be risk factors for CAD. In this regard, there are studies showing the effect of weather and climate changes on the incidence of CAD [4-6]. Increased blood pressure, changes in blood cholesterol, platelet, and erythrocyte levels, and the induction of vasospasm explain how weather and climatic conditions act as pathophysiological triggers in this process [7,8].

Acute coronary syndrome (ACS) has a broad spectrum of clinical manifestations, ranging from prolonged ischaemia to cardiac arrest. ACS should first be differentiated in two groups according to the electrocardiogram (ECG); first, myocardial infarction with ST segment elevation (STEMI), and second, myocardial infarction without ST segment elevation (NSTEMI) [9].

The association between meteorological factors and CAD, including ACS, has been studied [10]. Although there is evidence that there may be an association between some meteorological factors and ACS, there are insufficient studies to evaluate the association between meteorological factors and subgroups of ACS (STEMI, NSTEMI). Therefore, in this study, we aimed to evaluate the effect of meteorological factors such as air temperature, pressure, humidity, and wind on the number of STEMI admitted to the emergency department and to evaluate the potential effect modification of meteorological factors on STEMI, a subgroup of ACS.

2. Methods

2.1 Study Design and Population

In this retrospective and single-center study, we examined patients who presented to the emergency department with different symptoms and were subsequently diagnosed with STEMI and NSTEMI, and admitted to the coronary intensive care unit. The ethics committee's approval was obtained before data analysis (decision no. 2022/154).

Patients treated in the ED of a tertiary care teaching and research hospital in Turkey between March 1, 2021, and May 31, 2021, and admitted to the coronary intensive care unit after being diagnosed with STEMI and NSTEMI were included in the study. Patients who did not voluntarily accept the diagnosis and treatment, patients who were referred to another institution, patients under 18 years, and patients who could not be followed up were excluded from the study. The study population (n:265) was formed based on the exclusion and inclusion criteria.

The patient dataset was retrieved from the hospital's digital archive. The demographic data, comorbidities, smoking history, hospitalization diagnoses, and mortality of the patients enrolled in the study were investigated. Simultaneously, data such as air temperature, pressure, humidity, and wind were requested from the General Directorate of Meteorology for Rize province between March 1, 2021, and May 31, 2021, and then analyzed.

2.2 Endpoints

The primary endpoint was to determine whether meteorological data such as air temperature, pressure, humidity, and wind affect STEMI. The secondary endpoint was to determine whether meteorological data such as affected NSTEMI.

2.3 Statistical Analysis

All statistical analyses were conducted using Jamovi v1.6 software (Jamovi, version 1.6, Sydney, Australia). The type 1 error was 5% for all comparisons. Normality of data distribution was assessed using the Shapiro-Wilk test. Non-normal data for continuous variables were expressed as median and interquartile range (IQR), and normal data as mean and minimum-maximum. Categorical

data were expressed as frequencies (n) and percentages (%). The t-test for normally distributed groups and the Mann-Whitney U test for non-normally distributed groups were used to compare continuous variables. The positive distribution test was used to determine the presence or absence of disease, and Poisson regression analysis was used to identify factors that influenced the distribution.

3. 3. Results and Discussion

3.1 Results

Of the 265 patients included in the study, 202 (76.2%) were male, and 63 (23.8%) were female. The median age of the patients was 62, and the IQR was 55–71 years. The most common comorbid diseases were hypertension 149 (56.2%) and CAD 81 (30.6%). The diagnoses of patients admitted to the coronary intensive care unit were STEMI 144 (54.3%) and NSTEMI 121 (45.7%). The number of daily STEMI cases was ranged from 0 to 6. The number of daily NSTEMI cases was ranged from 0 to 4. Smoking history was 116 (43.8%), and the total death rate was 16 (6.0%). In the evaluation of meteorological factors, the median actual pressure was 1016 kPa, and the IQR 1011-1019 kPa; the median relative humidity was 78.6%, and the IQR 74.1-82.8%; the median wind speed was 1.1 m/sn, and the IQR 1.0-1.3 m/sn; the median temperature was 12.5 ^{0}C, and the IQR 8.4-16.8 ^{0}C; and the median rain 0 kg/m^2, and the IQR 0.0-2.5 kg/m^2. The patient's demographic data, baseline characteristics, and the meteorological data are shown in Table 1.

Statistical analysis between survivor and non-survivor groups showed that meteorological factors did not cause statistical differences between survivor and non-survivor groups. Statistical analysis of meteorological data by mortality is summarized in Table 2. When the meteorological factors affecting number of STEMI admissions were analyzed according to the Poisson distribution, it was seen that temperature among the meteorological factors affected number of STEMI admissions. A 1 ^{0}C increase in temperature caused a 5% increase in STEMI admissions (Odds Ratio: 1.05, 95% Confidence Interval: 1.001 - 1.110, p=0.036). The association between number of daily STEMI and meteorological factors according to Poisson distribution is summarized in Table 3. Similarly, when meteorological factors affecting NSTEMI were analyzed according to Poisson distribution, it was observed that meteorological factors did not affect the number of NSTEMI admissions.

The association between number of daily NSTEMI, and meteorological factors according to Poisson distribution is summarized in Table 4.

Table 1- The Patients' Demographic Data and Baseline Characteristics

Characteristics, n = 265	Value
Gender	
Male, n (%)	202 (76.2)
Female, n (%)	63 (23.8)
Age (years), median (IQR)	62.0 (55.0-71.0)
Comorbidities	
Hypertension, n (%)	149 (56.2)
Diabetes, n (%)	75 (28.3)
CAD, n (%)	81 (30.6)
Atrial Fibrillation, n (%)	25 (9.4)
Stroke, n (%)	14 (5.3)
Cigarette, n (%)	116 (43.8)
Diagnostic of Hospitalization	
STEMI	144 (54.3)
NSTEMI	121 (45.7)
Daily Number of STEMI	
0	22 (23.9)
1	33 (35.9)
2	17 (18.5)
3	10 (10.9)
4	5 (5.4)
5	3 (3.3)
6	2 (2.2)
Daily Number of NSTEMI	
0	26 (28.3)
1	33 (35.9)
2	17 (18.5)
3	10 (10.9)
4	6 (6.5)
Meteorological Data	
Wind Speed (m/sn), median (IQR)	1.1 (1.0-1.3)
Rain (kg/m^2), median (IQR)	0.0 (0.0-2.5)
Relative Humidity (%), median (IQR)	78.6 (74.1-82.8)
Pressure (kPa), median (IQR)	1016 (1011-1019)
Temperature (^{0}C), median (IQR)	12.5 (8.4-16.8)
Mortality	16 (6.0)

IQR: *Interquartile Range (25p, 75p),* ***CAD****: Coronary Artery Disease,* ***STEMI:*** *Myocardial Infarction with ST Segment Elevation,* ***NSTEMI:*** *Myocardial Infarction without ST Segment Elevation*

Table 2- Meteorological Data According to Mortality

Meteorological Data	Survivor (n=249)	Non-Survivor (n=16)	P Value
Daily wind speed (m/sn), median (IQR)	1.1 (1.0-1.3)	1.2 (1.0-1.3)	0.198
Daily rain (kg/m^2), median (IQR)	0.0 (0.0-2.8)	0.0 (0.0-0.2)	0.681
Daily relative humidity (%), median (IQR)	78.8 (74.4-82.9)	77.5 (69.2-79.8)	0.259
Daily pressure (kPa), median (IQR)	1016 (1011-1019)	1014 (1010-1018)	0.343
Daily temperature (^{0}C), median (IQR)	12.5 (8.4-16.8)	14.3 (10.2-17.9)	0.193
IQR: *Interquartile Range (25p, 75p)*			

Table 3- Factors Affecting the Number of Daily STEMI According to Poisson Distribution

Meteorological Data	Odds Ratio	95 % CI	P Value
Daily wind speed (m/sn)	1.270	0.744 – 2.040	0.359
Daily rain (kg/m^2)	1.010	0.971 - 1.030	0.934
Daily relative humidity (%)	0.982	0.961 - 1.001	0.096
Daily pressure (kPa)	0.970	0.940 - 1.002	0.061
Daily temperature (^{0}C)	1.050	1.001 - 1.110	**0.036**
STEMI: *Myocardial Infarction with ST Segment Elevation,* ***CI:*** *Confidence Interval*			

Table 4- Factors Affecting the Number of Daily NSTEMI According to Poisson Distribution

Meteorological Data	Odds Ratio	95 % CI	P Value
Daily wind speed (m/sn)	0.906	0.510 - 1.510	0.722
Daily rain (kg/m^2)	0.986	0.953 - 1.020	0.387
Daily relative humidity (%)	1.010	0.987 - 1.030	0.408
Daily pressure (kPa)	1.010	0.969 - 1.030	0.989
Daily temperature (^{0}C)	0.978	0.937 - 1.020	0.327
NSTEMI: *Myocardial Infarction without ST Segment Elevation,* ***CI:*** *Confidence Interval*			

3.2 Discussion

Studies show climate change influences the incidence of ACS [4-6]. Weather and climatic conditions act as pathophysiological triggers by increasing blood pressure, altering blood cholesterol, and platelet, and erythrocyte levels, and inducing vasospasm [7,8]. Accordingly, our study evaluated the effect of meteorological factors such as temperature, pressure, humidity, and wind on STEMI and NSTEMI presentation to ED. Our results show that among the meteorological factors, temperature impacts the number of STEMI admissions to the ED.

Li et al. examined the seasonality of ACS and its relationship with meteorological parameters. They found that temperature, and pressure were negatively related to the occurrence of ACS [11]. Again, Wang et al. examined the relationship between air temperature, and ACS. Low air temperature was a risk factor for ACS in elderly patients [12]. In another study, Panagiotakos et al. investigated the effect of meteorological factors on hospital-admitted ACS and found an increase in the incidence of ACS with cold weather [13]. In our study, the relationship between meteorological factors, and the incidence of STEMI was examined, and it was found that a 10C increase in temperature increased the incidence of STEMI by 5%. Our findings support the findings of previous studies the cause both warming, and cooling of the air towards extreme values have an increasing effect on the occurrence of ACS [14,15].

Li et al. examined the relationship between daily temperature, and subtypes of acute coronary syndromes. They found that STEMI was associated with high daily temperature, and NSTEMI with low daily temperature [15]. Although the primary endpoint of our study was to evaluate the relationship between meteorological factors, and the number of STEMI admissions, our secondary endpoint was to evaluate the relationship between meteorological factors, and emergency admissions in both STEMI and NSTEMI. The number of STEMI admissions was found to be associated with high temperature. However, no relationship was found between meteorological factors, and the number of NSTEMI admissions. In the light of our findings, we also observed that meteorological factors other than temperature were not associated with STEMI. Although this observation correlates with many studies in the literature, there are also studies with contrary findings [11,16].

In our study, the relationship between meteorological factors, and mortality was examined.

No relationship was found between meteorological factors, and mortality. This may be because our study covered only one seasonal period. Since we could not evaluate seasonal differences, we may have concluded that meteorological factors are unrelated to mortality. This is mentioned in the limitation section of our study.

ACS is explained by a multifactorial mechanism, and metrological factors are only one of the factors that trigger ACS. Although it seems to be a weak factor on its own, considering that it may create a domino effect, patients may be advised to change their lifestyle (giving up sedentary life, doing sports, etc.) as well as changing their place of residence. In addition, considering the relationship between temperature, and STEMI, it may be considered to organise the pre-hospital system (112, 911, etc.) accordingly for fast and effective access to STEMI cases that will increase in hot weather.

Limitations, This study has some limitations. In particular, the study was small in scope, single-center, and retrospective. Also, similar to other retrospective studies, there were concerns about the possibility of selection bias. However, considerable sensitivity was shown to eliminate this concern. Finally, limitation is the single, and short seasonal period analyzed. To confirm our findings, further studies with larger numbers of patients and more centres are needed.

4. Conclusion This study shows that STEMI admissions increase with high temperature. In this direction, it may be considered to organize the pre-hospital system (112, 911, etc.) accordingly for fast, and effective access to STEMI cases that will increase in hot weather.

5. Acknowledgment We would like to express a special thank to Emergency Department of Recep Tayyip Erdoğan University Training and Research Hospital

6. References

1. World health statistics 2023: monitoring health for the SDGs, sustainable development goals. https://www.who.int/publications/i/item/9789240074323 Accessed: November 21, 2023.
2. Death and Cause of Death Statistics, 2022. https://data.tuik.gov.tr/Bulten/Index?p=Olum-ve-Olum-Nedeni-Istatistikleri-2022-49679 Accessed: November 23, 2023.
3. Libby P, Bonow RO, Zipes DP. Braunwald's heart disease: a textbook of cardiovascular medicine. Philadelphia: W.B. Saunders Company; 2007.
4. Douglas AS, Dunnigan MG, Allan TM, et al. Seasonal variation in coronary heart disease in Scotland. J Epidemiol Community Health 1995;49:575-82.
5. Danet S, Richard F, Montaye M, et al. Unhealthy effects of atmospheric temperature and pressure on the occurrence of myocardial infarction and coronary deaths. A 10-year survey: the Lille-World Health Organization MONICA project (Monitoring trends and determinants in cardiovascular disease). Circulation. 1999;100(1):E1-7.
6. Dilaveris P, Synetos A, Giannopoulos G, et al. Climate impacts on myocardial infarction deaths in the Athens territory: the CLIMATE study. Heart 2006;92:1747-51.
7. Staiger H, Laschewski G, Gratz A. The perceived temperature - a versatile index for the assessment of the human thermal environment. Part a: scientific basics. Int J Biometeorol. 2012;56(1):165–76.
8. Keatinge WR, Coleshaw SR, Cotter F, et al. Increases in platelet and red cell counts, blood viscosity, and arterial pressure during mild surface cooling: factors in mortality from coronary and cerebral thrombosis in winter. Br Med J (Clin Res Ed). 1984;289(6456):1405–8.
9. Thygesen K, Alpert JS, Jaffe AS, et al. Executive Group on behalf of the Joint European Society of Cardiology (ESC)/American College of Cardiology (ACC)/American Heart Association (AHA)/World Heart Federation (WHF) Task Force
1. for the Universal Definition of Myocardial Infarction. Fourth Universal Definition of Myocardial Infarction (2018). J Am Coll Cardiol. 2018;72(18):2231-2264.
10. Phung D, Thai PK, Guo Y, et al. Ambient temperature and risk of cardiovascular hospitalization: an updated systematic review and meta-analysis. Sci Total Environ. 2016;550:1084–102.
11. Li Y, Du T, Lewin MR, et al. The seasonality of acute coronary syndrome and its relations with climatic parameters. Am J Emerg Med. 2011;29(7):768-74.
12. Wang X, Jiang Y, Bai Y, et al. Association Between Air Temperature and the Incidence of Acute Coronary Heart Disease in Northeast China. Clin Interv Aging. 2020;15:47-52.
13. Panagiotakos DB, Chrysohoou C, Pitsavos C, et al. Climatological variations in daily hospital admissions for acute coronary syndromes. Int J Cardiol. 2004;94(2-3):229-33.
14. Konat A, Sharma K, Chandel D. Impact of atmospheric variables on incidence of acute coronary syndrome amongst Gujarati Asian Indians - IOAPIC study. Indian Heart J. 2023;75(3):203-209.
15. Li N, Ma J, Liu F, et al. Associations of apparent temperature with acute cardiac events and subtypes of acute coronary syndromes in Beijing, China. Sci Rep. 2021;11(1):15229.
16. Huang CH, Lin HC, Tsai CD, et al. The Interaction Effects of Meteorological Factors and Air Pollution on the Development of Acute Coronary Syndrome. Sci Rep. 2017;7:44004.