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Relationship of ST-segment elevation myocardial infarction with weather and season

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Abstract

Myocardial infarction (MI) is a leading cause of mortality and morbidity. The most lethal subgroup of MI patients is ST-segment elevation myocardial infarction (STEMI). This study aims to investigate the relationship between STEMI patients and weather conditions, as recent studies suggest that environmental factors may contribute to the development of STEMI. The study analysed STEMI patients. The study recorded the weather conditions of patients on the days they were admitted to the hospital. The data collected included daily average air temperature (in Celsius), dew point (in Celsius), humidity (as a percentage), weather condition (fair, cloudy, windy, or rainy), wind speed (in rpm), pressure (in inches) obtained via the API where previous data is stored, and precipitation (in inches). This data was then matched with the patients. Although 8 (4.23%) of the participants died, there was no significant difference observed in the comparison of demographic and laboratory data. When comparing the impact of seasonal changes on mortality in STEMI patients, we found that the average humidity during the admission period was significantly lower for patients who did not survive (39.87±9.76) compared to those who did (p=0.022). However, we did not observe any significant effects on mortality from air temperature, Dew Point, Wind speed, Wind gust, or pressure (P value respectively; 0.506, 0.181, 0.063, 0.684). The humidity levels during the admission period significantly affect the mortality rates of STEMI patients, depending on the prevailing climatic conditions.

Keywords: Myocardial infarction, ST-segment elevation myocardial infarction, weather

Introduction

It is crucial to act decisively in order to prevent mortality and morbidity resulting from myocardial infarction (MI), which is a frequent cause for emergency department admissions. ST-segment elevation myocardial infarction (STEMI) is a highly lethal subgroup of MI patients, accounting for approximately one-third of cases [1,2]. Urgent treatment is required for this fatal condition, as STEMI patients present to the emergency room with symptoms such as sudden and severe chest pain, shortness of breath, sweating, nausea, and vomiting. Risk factors for the condition include genetic factors, age, gender, nutritional habits, exercise routine, obesity, smoking, high blood pressure, and high cholesterol [3].

Studies have unequivocally shown that environmental factors contribute to the development of STEMI. Weather conditions and pollution are well-established atherothrombotic risk factors that affect a wide population [4]. Cold weather, particularly during the winter months, has a significant negative impact on heart health. Cold weather restricts blood flow by causing vasoconstriction in the vessels, which increases the risk of acute cardiovascular events, ranging from sudden death to unstable angina [5]. Although some studies have reported an increase in the occurrence of STEMI during hot weather, there is little information on seasonal variations in the onset of disease symptoms, and data on the role of environmental temperature are conflicting [6]. Fine particles in the atmosphere have been reported to increase cardiovascular morbidity and mortality. Recent studies have aimed to understand the effect of pollution and weather conditions on atherothrombosis [7,8]. However, the role of environmental temperature in the onset of acute MI symptoms remains unclear, and there is limited information on seasonal variations [9]. It confidently determines the presence of a seasonal variation in the development of STEMI. This study establishes a clear relationship between weather conditions and STEMI patients, despite conflicting reports on environmental factors.

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Material and Methods

The study analysed STEMI patients who visited the emergency department of a tertiary training and research hospital between 01.01.2021 and 12.31.2023, after receiving ethics committee approval and being referred for treatment from the emergency room.

Patients presenting to the emergency department with ST-segment elevation on ECG and confirmed by cardiology with interventional imaging were considered to have STEMI. The study included STEMI patients who were 18 years or older, while excluding non-STEMI patients, those under 18 years of age, and those with missing data.

The study examined a total of 189 patients and included data on age, gender, mortality, hemoglobin, platelet count, white blood cell count, and high-sensitivity troponin I values. Weather data was retrieved from WaterGround API for the Murtapaşa region of Antalya.

In the analysis performed with G-power 3.1, if the effect power is accepted as 0.5, the sample size required for the study to have a power of 0.95 with a 95% confidence interval and a 5% margin of error was determined to be 176 people, and there are 186 participants in our study.

Meteorological Data

The study recorded the weather conditions of patients on the days they were admitted to the hospital. The data collected included daily average air temperature (in Celsius), dew point (in Celsius), humidity (as a percentage), weather condition (fair, cloudy, windy, or rainy), wind speed (in rpm), pressure (in inches) obtained via the API where previous data is stored, and precipitation (in inches). This data was then matched with the patients. The data source for this study was the WaterGround website (https://www.wunderground.com). The study included data from the Murtapaşa region of Antalya (zip code: 07030), where the hospital is located.

Statistical Analysis

The data for this study was analysed using IBM SPSS version 27, and the graphics were prepared using Graphpad Prism 8. The database was created from the data obtained from the hospital information management system and the data obtained through the API. Categorical data was analysed using frequency and percentage values, while numerical data was analysed using normal distribution analysis. Data that followed a normal distribution were presented as mean ± standard deviation, while data that did not follow a normal distribution were presented as median (interquartile range).

The analysis of categorical variables employed the Chi square test, while numerical variables that conformed to normal distribution were analysed using the t-test. Nonparametric tests were used for numerical variables that did not conform to normal distribution. ROC analysis was performed for numerical values that showed significant results in the comparisons. Results with a p value below 0.05 were considered significant.

Results

Although 8 (4.23%) of the participants died, there was no significant difference observed in the comparison of demographic and laboratory data. Please refer to Table 1 for the data distribution. The mortality rates of hospital patients varied by season (Chi-square=19.96, p=0.045). The highest mortality rate was observed in June (37.5%) (Figure 1a). However, there was no significant difference in mortality rates between seasons (Chi-square=5.637, p=0.13, Figure 1b), and weather conditions did not have a significant effect on mortality (Chi-square=2.784, p=0.426, Figure 1c).

Table 1. Demographic and laboratory data

	Live (n=181)	Exitus (n=8)	p-value
Gender (Male (%))	149 (82.3)	7 (87.5)	0.370
Age (Mean±SD)	62.28±12.96	64.25±15.91	0.697
Hb (Mean±SD)	13.88±2.51	13.17±2.70	0.438
Plt (Mean±SD)	261.94±84.38	222.62±121.88	0.208
WBC (Mean±SD)	11.9±7	15.08±3.58	**0.044**
HsTropI (Median(IQR)	3 (247.76)	387.65 (1480.99)	0.126
LDH (Median (IQR))	213.5 (92.25)	493 (2273.75)	0.328

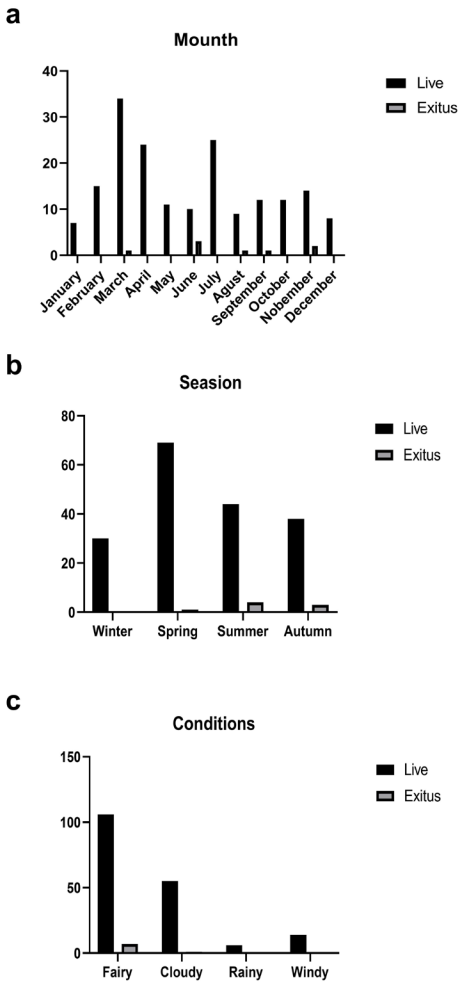

Figure 1. Relationship between factors for STEMI mortality **a.** months **b.** session **c.** conditions

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When comparing the impact of seasonal changes on mortality in STEMI patients, we found that the average humidity during the admission period was significantly lower for patients who did not survive (39,879.76%) compared to those who did (p=0.022). However, we did not observe any significant effects on mortality from air temperature, Dew Point, Wind speed, Wind gust, or pressure (Table 2). The ROC analysis conducted using WBC and Humidity yielded an AUC of 0.758 (p=0.001) for the WBC value. At the cut-off value of 15.18, the sensitivity was 81.18% and the specificity was 75%. No significant results were found for humidity (refer to Table 3 and Figure 2).

Table 2. Seasonal changes on mortality

	Live (n=181)	Exitus (n=8)	p-value
Temperature	21.3±8.49	24.93±6.4	0.506
Dew Point	7.92±7.41	9.86±5.39	0.181
Humidity	43.58±21.05	39.87±9.76	**0.022**
Wind Speed	9.62±6.14	9.5±3.07	0.063
Wind Gust	0.64±4.95	0	0.548
Pressure	29.73±0.19	29.74±0.16	0.684

Table 3. ROC analysis for STEMI mortality

	AUC	SD	P-value	Cut-off	Sensitivity	Specificity
WBC	0.758	0.075	0.001	15.18	81.18	75
Humidity	0.497	0.063	0.956	28.5	29.3	100

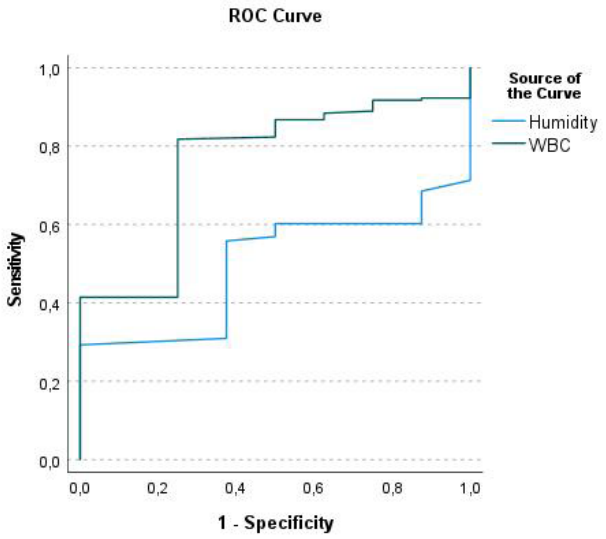

Figure 2. ROC analysis for STEMI mortality

Discussion

There are changes in the incidence of diseases due to climatic differences. In a study conducted by Sahin and Gur, it was observed that epileptic seizures increased when temperature, relative humidity and wind speed were low [10]. However, in a study conducted by Basaran and Sahin, it was observed that the number of vertigo patients increased in the summer months and was related to humidity [11].

Other climatic conditions, such as air temperature, dew point, weather conditions, wind speed, pressure, and precipitation, did not show any significant correlation with mortality. These findings highlight the importance of considering humidity levels when treating STEMI patients. The study clearly demonstrates that there is a significant correlation between mortality in STEMI patients and humidity levels during the admission period.

Studies investigating the correlation between weather conditions and MI have not provided a clear understanding of the relationship between meteorological factors and the disease. However, research has shown that both increases and decreases in air temperature are associated with MI [12]. Additionally, Kozlovskaia et al. conducted a study that showed no increase in cases during periods of mild temperature [13]. Vallabhajosyula et al. have demonstrated that in-hospital mortality rates increase during winter months and decrease during summer months for both STEMI and NSTEMI admissions, as well as for the entire MI cohort [14. Patlolla et al. have reported that MI admissions during winter are associated with lower rates of coronary angiography and higher in-hospital mortality rates compared to other seasons [15]. Our study confidently concludes that there is no relationship between mortality in STEMI patients and air temperature. It is important to note that while some studies suggest a correlation between atmospheric pressure and cardiovascular diseases, our findings indicate no significant relationship [16,17].

A study found a positive correlation between STEMI and increased atmospheric pressure [18]. Hong et al. reported that a sudden drop in air pressure was associated with a higher probability of STEMI events 7 days after exposure [19]. However, the relationship between the seasonal variation of acute myocardial infarction and relative humidity remains unclear. Lower relative humidity and longer sunlight duration were found to be significantly associated with increased daily hospital admissions for acute myocardial infarction [20]. STEMI was also found to be associated with an increase in humidity [5]. Furthermore, a study conducted in Greece reported a 2% increase in hospital admissions for every 1% increase in relative humidity [21]. Although we did not find a significant relationship between mortality and other climatic conditions, our findings support the notion that humidity plays a crucial role in the health outcomes of patients. Our study demonstrated that average humidity during the admission period had a significant effect on patients who could not survive the climatic conditions. These results provide valuable insights into the impact of climatic conditions on patient health and can inform future research and policy decisions.

The impact of weather on patients with ST-elevation myocardial infarction (STEMI) is complex, and several meteorological factors influence the incidence and severity of myocardial infarction. Extreme weather conditions, especially low perceived temperatures, have been shown to significantly increase the risk of STEMI, especially in men, suggesting a gender-specific

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vulnerability to cold weather [22]. In temperate Mediterranean climates, both temperature extremes and changes in relative humidity have been associated with an increased risk of STEMI, with a significant effect of temperature drops two days before the event and humidity changes three days before the event [23]. Short-term changes in air pressure and temperature are also associated with higher rates of hospitalization for acute coronary syndromes, including STEMI, and men and older adults are particularly sensitive to these climatic changes [24]. In China, short-term changes in air pressure and temperature were significantly associated with STEMI events, highlighting the importance of abrupt weather changes in cardiac events [25].

Although our study has some limitations, we can confidently state that focusing solely on in-hospital mortality in STEMI patients does not provide a comprehensive understanding of all factors contributing to mortality. Furthermore, due to uncertainty surrounding the exact onset time and duration of patients' chest pain and symptoms, it is possible that the immediate impact of climatic conditions may not be fully detected. Retrospective recording of climatic conditions may not clearly detect instantaneous weather changes. Our study is limited by the inability to determine the admission conditions of patients and the climatic conditions at symptom onset. However, our findings suggest that prospective multicenter studies are necessary to gain a better understanding of the relationship between climatic conditions and health outcomes.

It is imperative that the effects of seasonal and meteorological variables be taken into account in the planning of work and the development of policies pertaining to STEMI, which is a social problem, and the selection of appropriate intervention methods.

Conclusion

The humidity levels during the admission period significantly affect the mortality rates of STEMI patients, depending on the prevailing climatic conditions.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

This study protocol was reviewed and approved by Health Science University Antalya Training and Research Hospital Clinical Research Ethics Committee. (Date: 04/05/2023, Approval number: 6/7, File number: 2023-083).

References

1. Milasinovic D, Nedeljkovic O, Maksimovic R, et al. Coronary Microcirculation: The next frontier in the management of STEMI. J Clin Med. 2023;12:1602.
2. McAlindon E, Pufulete M, Harris J, et al. Microvascular dysfunction determines infarct characteristics in patients with reperfused ST-segment elevation myocardial infarction: The MICROcirculation in Acute Myocardial Infarction (MICRO-AMI) study. PLoS One. 2018;13:e0203750.
3. Núñez-Gil IJ, Riha H, Ramakrishna H. Review of the 2017 European Society of Cardiology's Guidelines for the Management of Acute Myocardial Infarction in Patients Presenting with ST-Segment Elevation and Focused Update on Dual Antiplatelet Therapy in Coronary Artery Disease Developed in Collaboration with the European Association for Cardio-Thoracic Surgery. J Cardiothorac Vasc Anesth. 2019;33:2334-43.
4. Kobayashi S, Sakakura K, Jinnouchi H, et al. Influence of daily temperature on the occurrence of ST-elevation myocardial infarction. J Cardiol. 2023;81:544-52.
5. Panagiotakos DB, Chrysohoou C, Pitsavos C, et al. Climatological variations in daily hospital admissions for acute coronary syndromes. Int J Cardiol. 2004;94:229-33.
6. Rus AA, Mornoş C. The impact of meteorological factors and air pollutants on acute coronary syndrome. Curr Cardiol Rep. 2022;24:1337-49.
7. Zhang H, Yi M, Wang Y, et al. Air pollution and recurrence of cardiovascular events after ST-segment elevation myocardial infarction. Atherosclerosis. 2022;342:1-8.
8. Urbanowicz T, Skotak K, Filipiak KJ, et al. Long-term exposure of nitrogen oxides air pollution (NO2) impact for coronary artery lesion progression-pilot study. J Pers Med. 2023;13:1376.
9. Malakar AK, Choudhury D, Halder B, et al. A review on coronary artery disease, its risk factors, and therapeutics. J Cell Physiol. 2019;234:16812-23.
10. Sahin L, Gur A. Association of the meteorological parameters and epileptic seizures. Int J Crit Care Emerg Med. 2023;9:151.
11. Basaran MM, Sahin L. Climatic variations and pollution on benign paroxysmal positional vertigo in Kars, Türkiye. Environ Res. 2023;237:116985.
12. Sun Z, Chen C, Xu D, Li T. Effects of ambient temperature on myocardial infarction: a systematic review and meta-analysis. Environ Pollut. 2018;241:1106-14.
13. Kozlovskaia IL, Bulkina OS, Lopukhova VV, et al. Trends in hospitalizations of patients with acute coronary syndrome and indicators of the atmospheric state in Moscow in 2009-2012. Ter Arkh. 2014;86:20-6.
14. Vallabhajosyula S, Patlolla SH, Cheungpasitporn W, et al. Influence of seasons on the management and outcomes acute myocardial infarction: an 18-year US study. Clin Cardiol. 2020;43:1175-85.
15. Patlolla SH, Kanwar A, Sundaragiri PR, et al. Seasonal variation in the management and outcomes of cardiac arrest complicating acute myocardial infarction. QJM. 2022;115:530-6.
16. Radke KJ, Izzo JL Jr. Seasonal variation in haemodynamics and blood pressure-regulating hormones. J Hum Hypertens. 2010;24:410-6.
17. Verberkmoes NJ, Soliman Hamad MA, Ter Woorst JF, et al. Impact of temperature and atmospheric pressure on the incidence of major acute cardiovascular events. Neth Heart J. 2012;20:193-6.
18. Goerre S, Egli C, Gerber S, et al. Impact of weather and climate on the incidence of acute coronary syndromes. Int J Cardiol. 2007;118:36-40.
19. Hong Y, Graham MM, Rosychuk RJ, et al. The effects of acute atmospheric pressure changes on the occurrence of ST-elevation myocardial infarction: a case-crossover study. Can J Cardiol. 2019;35:753-60.
20. Didier R, Le Ven F, Ouchiha M, et al. Analysis of weather exposure 7 days before occurrence of ST-segment elevation myocardial infarction. Arch Cardiovasc Dis. 2020;113:22-30.

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21. Lee JH, Chae SC, Yang DH, et al. Influence of weather on daily hospital admissions for acute myocardial infarction (from the Korea Acute Myocardial Infarction Registry). Int J Cardiol. 2010;144:16-21.

22. Kienbacher CL, Kaltenberger R, Schreiber W, et al. Extreme weather conditions as a gender-specific risk factor for acute myocardial infarction. Am J Emerg Med. 2021;43:50-3.

23. Vieira S, Santos M, Magalhães R, et al. Atmospheric features and risk of ST-elevation myocardial infarction in Porto (Portugal): A temperate Mediterranean (Csb) city. Revista Portuguesa de Cardiologia. 2022;41:51-8.

24. Rus AA, Lazăr MA, Negrea R, et al. Short-term changes in weather conditions and the risk of acute coronary syndrome hospitalization with and without ST-segment elevation: a focus on vulnerable subgroups. Medicina (Kaunas). 2024;60:454.

25. Jia EZ, Liu Z, Chen AJ, et al. Meteorological parameters and the onset of chest pain in subjects with acute ST-elevation myocardial infarction: an eight-year, single-center study in China. Cell Physiol Biochem. 2014;34:1589-96.