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Influence of weather in the incidence of acute myocardial infarction in Galicia (Spain)☆

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ABSTRACT

Objective: To assess the interactions between weather and the impact of each individual meteorological parameters in the incidence of acute myocardial infarctions (AMI) in Galicia.
Methods: Retrospective study analyzing the number of AMI diagnosed and transferred to the hospital by the Emergencies Sanitary System of Galicia between 2002 and 2009. We included patients with clinical and ECG findings of AMI. The correlation between 10-minute meteorological variables (temperature, humidity, pressure, accumulated rainfall and wind speed) recorded by MeteoGalicia and the incidence of AMI was assessed.
Results: A total of 4717 AMI were registered (72.8% men, 27.2% women). No seasonal variations were found. No significant correlations were detected with regard to average daily temperature ($P = .683$) or wind speed ($P = .895$). Correlation between atmospheric pressure and incidence of AMI was significant ($P < .005$), as well as with the daily relative humidity average ($P = .005$).
Conclusions: Our study showed a statistical significant association with atmospheric pressure and with the daily relative humidity average. Since the local conditions of weather are widely variable, future studies should establish the relationship between weather patterns (including combinations of meteorological parameters), rather than seasonal variations, and the incidence of AMI.

Influencia del clima en el infarto de miocardio en Galicia

Palabras clave:
Incidencia
Infarto agudo de miocardio
Clima
Parámetros meteorológicos

RESUMEN

Objetivo: Analizar la influencia del clima y el impacto de cada parámetro meteorológico sobre la incidencia del infarto agudo de miocardio (IAM) en Galicia.
Métodos: Estudio retrospectivo analizando el número de IAM diagnosticados y trasladados a hospitales por la Fundación Pública de Urgencias Sanitarias de Galicia-061 entre 2002 y 2009. Incluimos pacientes con criterios clínicos y electrocardiográficos de IAM, y analizamos su correlación con variables meteorológicas diezminutales (temperatura, humedad, presión, precipitaciones acumuladas y velocidad del viento) registradas por MeteoGalicia.
Resultados: Se incluyeron 4.717 infartos diagnosticados (72,8% varones y 27,2% mujeres), sin detectar variación estacional. La temperatura media diaria ($p = 0,683$) y la velocidad media del viento ($p = 0,895$) no mostraron relación significativa con la incidencia de IAM. La presión atmosférica presenta una asociación estadísticamente significativa con la incidencia de IAM ($p < 0,005$), así como la humedad relativa, asociada a una mayor incidencia en el cuarto cuartil ($p = 0,005$).

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Conclusiones: Nuestro estudio muestra una asociación estadísticamente significativa entre la presión atmosférica y la humedad relativa media diaria con la incidencia de IAM en Galicia. Dado que las condiciones locales en las diferentes estaciones son muy variables, los futuros trabajos deberían dirigirse a establecer la relación entre patrones climáticos (definidos por combinaciones de parámetros meteorológicos individuales), en lugar de variaciones estacionales, y la incidencia de IAM.

Introduction

Cardiovascular diseases are the leading cause of mortality in developed countries and represent a pressing problem for the sustainability of healthcare systems because of the significant amount of resources that they take up. The first few decades of the 20th century saw a progressive drop in mortality due to infectious diseases and a significant increase in coronary heart disease.[1]

The first studies of the influence of weather and climate on the incidence of acute myocardial infarction (AMI) date back to 1938.[2]

Although different studies have demonstrated that certain climatological variables such as environmental pressure, pressure gradient, temperature and wind are those with the greatest impact on the incidence of AMI, the cause–effect relationship and reasons for its seasonal variation remain unclear. Other studies conducted in countries as varied as Japan, China, Canada, Brazil, Germany, the United States and Australia have shown a high incidence of infarctions in winter and spring.[3,4]

The Eurowinter Study demonstrated that a reduction in ambient temperature of 1 °C was associated with an increased risk of suffering from an infarction. This increased risk could not be attributed solely to the traditional risk factors.[5]

Danet et al. found that a 10 °C drop in daily mean temperature was associated with a 13% increase in coronary episodes in males, with a stronger association in the oldest age group (55–64 years).[6]

Despite the fact that some studies have demonstrated an increased incidence in climates with extreme heat or cold, other studies conducted in subtropical areas did not find this seasonal variation, probably owing to the fact that these areas had a temperate climate rather than extreme temperatures.[7]

The objective of this study is to perform an analysis of the incidence and population characteristics (age, sex, distribution throughout the year) of acute coronary syndrome in Galicia (Spain) and of the influence of climate and impact of each meteorological parameter on the incidence of this syndrome.

Materials and methods

A retrospective study analysing the number of cases of AMI diagnosed and transferred to hospitals by the Galicia Public Foundation for Healthcare Emergencies 061 (FPUSG 061) between 1 January 2002 and 31 December 2009.

In Galicia, visits to pre-hospital urgent and emergency healthcare facilities are coordinated by FPUSG 061 through its Healthcare Emergency Coordination Headquarters (CCUS), which has an emergency healthcare transport network that comprises 10 healthcare ambulances with advanced life support, 2 medically equipped helicopters and 101 healthcare ambulances with basic life support.

In addition, the Galician Acute Myocardial Infarction Healthcare Programme (PGAIAM) establishes a specific and comprehensive healthcare protocol for patients with acute coronary syndrome with ST segment elevation. In this protocol, patients with revascularisation criteria are transferred to the haemodynamics reference centre.[8]

The study enrolled patients who, during the screening period, had precordial pain with ischaemic characteristics and, after undergoing a 12-lead electrocardiogram, met the criteria for acute coronary syndrome with or without ST elevation.

The meteorological data used were those recorded at different meteorological stations managed by MeteoGalicia. A potential correlation between different meteorological parameters and a clinical diagnosis of AMI was sought.

The population area studied covers an area of some 30,000 km^2 and some 2,800,000 inhabitants (*Instituto Galego de Estatística*, 2013), and is located in northwest Spain. It is characterised by the passage of cold fronts across the north Atlantic, mainly in autumn and winter, causing episodes of heavy rain. Spring is a transitional season, with less rain than in autumn and winter. Summer is characterised by high pressure. Distance from the sea, altitude above sea level and topography influence the distribution of precipitation. In the inland provinces (Ourense and Lugo), total annual precipitation ranges between 800 and 1000 mm. Temperatures are prone to seasonal variations, being lower in winter and higher in summer, and to greater temperature differences between summer and winter. The provinces on the Atlantic coast (A Coruña and Pontevedra) have a climate with a less pronounced annual temperature cycle.

A total of 5092 patients clinically diagnosed with an infarction were enrolled in the study. The following variables were analysed: patient age and sex, wind speed, humidity, temperature and atmospheric pressure on the day of the infarction.

Depending on the place where the coronary episode was diagnosed, each patient was transferred to one of the 14 reference hospitals throughout Galicia and assigned the nearest meteorological station, where the following meteorological variables selected for the study were recorded at 10-min intervals:

- Daily mean temperature, in °C (DMT).
- Percentage of daily mean relative humidity (RH).
- Daily mean pressure, in hPa (PR).
- Daily mean wind speed, in m/s (WS).

Each of these variables was assigned daily to its meteorological station and assessed in 4 interquartile ranges, which yielded the entire log for the 8 years of the study in specific quartiles by variable and season. The 4 quartiles were: Q1 if the variable for that day was in the 0–25% range for the variable; Q2 if the range was 25–50%; Q3 if it was 50–75%; and Q4 if it was 75–100%. Obviously, the cut-off points for the quartiles were different for each station, and therefore for each reference hospital. However, this way, each infarction was associated with a recorded date, hospital and meteorological station. According to these parameters and the variable analysed, each infarction was assigned to one of the 4 interquartile classes (Q1, Q2, Q3 or Q4) corresponding to its reference hospital, thereby eliminating the bias of potential climate differences between each zone.

Those infarctions that did not have associated meteorological data were omitted from the analysis, so the number of cases may vary depending on the meteorological variable studied.

The statistical analysis used to make comparisons and determine whether the proportion of infarctions is similar in each of the 4 quartiles was the chi-squared test, and the following hypothesis was proposed: