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Meteorological factors and psychiatric emergencies

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Introduction. Studies conducted in the psychiatric setting and related with biometeorology generally coincide that there is a seasonal rhythm between seasons and depressive disorders, violent suicides and manic episodes. However, there are many discrepancies about the correlation of specific meteorological variables with the remaining clinical pictures. This work has aimed to study a wide sample of psychiatric cases in this area (Baix Camp/Tarragona) to see whether there is a relationship between meteorological variables and the total number of daily emergencies.

Method. We recorded the data of 3,048 cases attended in the Emergency Department of the Hospital Pere Mata de Reus (Tarragona) from January 1, 2003 to December 31, 2005. The possible relationship between the number of daily visits and different meteorological endpoints (such as wind direction and speed, temperature, humidity, atmospheric pressure and solar radiation) were analyzed statistically.

Results. The results were statistically significant for the meteorological endpoints of medium temperature (TMED), maximum temperature (TMAX) and minimum temperature (TMIN). The relationship between humidity and number of daily visits was also statistically significant (non-linear form). The remaining comparisons did not reach statistical significance.

Conclusions. The main conclusion of our study is that there is a direct relationship between environmental temperature increase and the number of patients attended in the hospital emergency department. A relationship could also be observed in regards to humidity. This fact may suggest the need to have suitable medical attendance planning for the hottest and most humid periods.

Key words:

Meteorology. Psychiatry emergencies. Biometeorology. Weather.

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Factores meteorológicos y urgencias psiquiátricas

Introducción. En el ámbito psiquiátrico los trabajos relacionados con la biometeorología suelen coincidir al reconocer un ritmo estacional en la presentación de los trastornos depresivos, suicidios violentos y episodios maníacos, existiendo discrepancias respecto a la correlación con otros cuadros. El objetivo de este trabajo es revisar una amplia muestra de población residente en las comarcas del Baix Camp/Tarragona, atendida en el Servicio de Urgencias de nuestro hospital, con el fin de valorar si existen variables meteorológicas que se correlacionen con el número total de urgencias diarias.

Metodología. Se recopilan los datos de 3.048 visitas atendidas en el Servicio de Urgencias del Institut Pere Mata de Reus (Tarragona) desde el 1 de enero de 2003 hasta el 31 de diciembre de 2005. Se analiza estadísticamente la posible relación entre el número de visitas diarias y las distintas variables meteorológicas (dirección y velocidad del viento, temperatura, humedad, presión atmosférica y radiación solar).

Resultados. Los resultados fueron estadísticamente significativos para las variables de temperatura media (TMED), temperatura máxima (TMAX) y temperatura mínima (TMIN). La relación entre la humedad y el número de visitas diarias también fue estadísticamente significativa (distribución no lineal). El resto de comparaciones no alcanzaron significación estadística.

Conclusiones. Se constata la existencia de una relación directa entre el incremento de la temperatura ambiental y el aumento en el número de pacientes atendidos de urgencia. Respecto a la humedad también se pudo evidenciar una relación. Este hecho puede sugerir la necesidad de una adecuada planificación asistencial durante los periodos más cálidos y húmedos.

Palabras clave:

Meteorología. Urgencias psiquiátricas. Biometeorología. Tiempo.

INTRODUCTION

There is a tendency to relate certain psychic and somatic, pathological manifestations with well-defined climatic and meteorological situations by both the health care professionals who perceive greater care pressure during some specific periods and by the patients who are capable of identifying fluctuations in their psychological condition in relationship with the time changes.

This fact, that was already suspected in the hippocratic writings (specifically in the trial «on the air, water and places», dated at about 400 B. C.¹), would be related with that which we currently understand as ecological concept of the disease. Since then, several authors have continued to perform studies along this line, until forming what is now a discipline known as Biometeorology. This studies the relationship of the seasonal and climatic changes with physical and mental health of a sector of the population²⁻⁵. Those individuals who are especially vulnerable to these changes are called «meteorosensitive», considering that between 30%-60% of the general population would belong to this group and that females (during menstruation and menopause) and those in the elderly groups would be especially affected^{3,4,6}. This greater affect of women by the climate changes has not been seen in some recent studies⁷.

There are many studies within the field of psychiatry that have tried to relate the presence of psychopathological changes with climatic changes, hinting at the possibility of a meteorological influence on the functional dynamics of cerebral neurotransmitters. This would mean that, in addition to the subjective or psychological elements, there is a biological reality that is explained by the laws of psychocchemistry and electrophysiology^{2,5}.

It is currently accepted that biometeorology may have an influence in the field of psychiatry, in mood state disorders and in the «seasonal affective syndrome» (SAD)^{8,9,10}, in violent suicide^{6,11,12} and in some criminal behaviors¹³. The so-called «meteoropathic front» («Föhn effect») consisting in a conjunction of low pressures, environment dryness and increase of positive ionization of the atmosphere seems to condition alterations in the 5HT levels that may be related with greater aggressivity anxiety, depression and affective biphasic reactions³. This decrease of serotonin is also related by Preti et al. (1997) with violent suicides¹⁴. In summary, certain functional alterations on the level of the limbic-hypothalamic system and the pineal gland may be involved in the appearance of these pictures¹⁵.

There are also many studies that have been conducted on the relationship between environmental factors and other diseases such as recurrent depressive disorder, bipolar depression or schizophrenia. Boyce and Parker (1988) analyzed the influence that environmental temperature and humidity could have on these disorders, finding a positive relationship with light but not with temperature¹⁶.

In any case, the results do not always agree. After studying a representative sample of the Dutch population, De Graaf et al. (2005) only detected limited seasonal variations of mental disorders, a fact that they attributed to the mild climate they enjoyed⁷. Other authors seriously doubt the consistency of the «meteoropsychopathological» relationship, indicating that many other factors outside of the meteorological variables that may significantly condition the time period of the disorders were not analyzed in these studies^{6,17}.

However, it is clear that those works established on the bases explained on meteorotropism and psychopathology and that study the possible influence of meteorology in the demand for emergency psychiatric care are of special interest for us. The contribution of San Gil et al.^{2,15,18,19} should be stressed. This demonstrates that the total number of emergencies/day is an atmospheric time-dependent meteorotropic variable. Although classical national works on this subject such as those of García Carretero et al. (1986) recognize certain influence of temperature and degree of isolation in the emergencies generated by certain diagnostic groups, they stress that there is a clear multifactorial meteorological character and not a single factor that is capable of precipitating a certain psychiatric condition in meteorosensitive persons. These authors recognize a maximum peak of care in summer and another one in the month of November⁶. When San Gil et al. (1988) studied psychiatric admissions in the island of Tenerife, they stressed, among other associations, the direct influence of temperature and the inverse one of relative humidity and barometric pressure during the heat waves on suicide attempts and psychomotor agitation syndrome¹⁸. After reviewing more than 1,500 psychiatric emergencies, Gómez Gonzalez (1998) observed a slight increase of admissions in summer, during the days with more hours of sun⁴.

Mondai, Kikinon and Valevski (1994) state that the seasonal variability and climatic factor have been demonstrated to predict the hospital admissions in patients with major psychiatric disorders²⁰. More recently, Santiago et al. (2005) evaluated the influence that factors such as temperature, precipitation, speed and direction of the wind and light could have on the number of evaluations made in emergency department and on admissions. They found a significant correlation between temperature and number of visits to psychiatric emergencies in a series of 1909 patients evaluated during one year in hospital centers in California. These authors concluded that the admissions were more frequent on hot and dry days²¹.

Different authors consider that it is fully justified to conduct new studies on the subject in cities having significant meteorological variation^{7,21}.

The reason we decided to conduct this study was to try to establish a correlation between meteorological variables and the number of psychiatric emergencies (care pressure), without going deeply into what type of meteorological profiles appear on the days having the greatest care pressure,

which diseases are especially affected and if there are differences between different population groups, although orientational data are presented in this sense as a basis for future works.

The establishment of this correlation would make it possible to establish the period of greatest care pressure in the emergency departments and to make a more adequate distribution of the care resources.

METHODOLOGY

This is a retrospective study of psychiatric emergencies seen in the Emergency Department of the Hospital Psiquiátrico Universitario Institut Pere Mata de Reus (HPUIPM) during the years 2003, 2004 and 2005. The center in question is a monographic hospital whose emergency department only attends to psychiatric conditions. The following endpoints were studied: gender, age, date, residence population, diagnosis according to International Classification of Disease-9-Clinical Modification (ICD-9-CM) and need for admission. The scheduled admissions were not included in the database for the following reasons: in the first place because they were admissions made from the Mental Health Center and thus did not significantly contribute to the care pressure in the emergency department and, on the other hand, because they did not always adapt to clinical emergencies but rather there were other possible admission criteria.

Visits, and not patients, were counted in the study, it being possible that the same patient could come to several visits in the period analyzed.

The corresponding meteorological data were obtained from the registry of the Botarell Meteorological Service Station of Catalunya (MSS). This database collects the daily values for the following endpoints: wind direction and speed, temperature (mean, maximum and minimum), relative humidity, real atmospheric pressure and solar radiation. The comorbidity factor was not considered since only the principal diagnosis related with the visit was included in the data base, and the effect of the possible combination of more than one atmospheric variable was not even included.

The geographic area for which the meteorological data reports (a large part of the Baix Camp [in Catalonia]) was representative was determined, excluding those patients who came from populations outside of the previously established limits (Hospitalet de L'Infant and Vandellós) from the study. There are 168,405 inhabitants from the region of Baix Camp (excluding the previously mentioned populations). The 0-14 year old age group accounts for 15.9% of the total, while those over 65 years represent 14.7% of the population.

During 2005 in Catalonia, the global care pressure was 10,583,854 visits in out-patient consultations and 4,443,051 in emergency departments. A total of 112,302 psychiatric vi-

sits were made in the out-patient visits and 26,198 in emergency departments of psychiatric centers. Of these, 1,190 were seen in our hospital.

A data base was created with all of the material collected and its computer processing. The data were analyzed using the SPSS® program, version 12.0.1. Comparisons were made with the chi-squared tests and analysis of the variance (ANOVA), considering that there was a statistically significant difference if there was a $p < 0.05$.

RESULTS

Visits and admissions

A total of 3,048 visits and 498 admissions were made during the three years studied. This means that admission of the patient was considered necessary in 16.3% of the visits. There were no visits in 86 (7.9%) of the 1,095 days analyzed in the three year period studied, and the maximum number of visit on one day (9 visits) occurred in 3 (0.3%). Of the 1,009 days in which the visits were made, there were no admissions in 602 (59.7%) while the maximum number of daily admissions was 3, this occurring on 7 days (0.7%). The mean daily visits were 2.78 with a standard deviation of 1.74.

Gender

There is practically parity between genders in the 3,048 visits made: 50.7% correspond to women and 49.3% to men. However, more men (56.4%) than women (43.6%) were hospitalized.

Age

The predominant age group (about 33% of the total) was that ranging from 26 to 35 years, the age range between 25 and 55 years corresponding to approximately 80% of the visitors. Mean age of the patients seen corresponded to 39.37 years with a standard deviation of 16.14 years, the range of population studied being between 7 and 96 years.

Diagnosis

Regarding distribution by diagnostic groups, 25.7% of the 3,046 cases examined (in two cases, there was no diagnosis) corresponded to the neurotic disorders group and 20.7% to acute reactions to stress or adaptation. The sum of both practically represented half of the visits (46.4%). However, a low percentage of admissions were referred (6.8% and 8.2%: 15% of the total). Schizophrenic disorders (15% of the visits) and affective psychoses (9.15% of the visits) accounted for almost half of the admissions (31.3% and 17.9%: 49.2%) (fig.1).

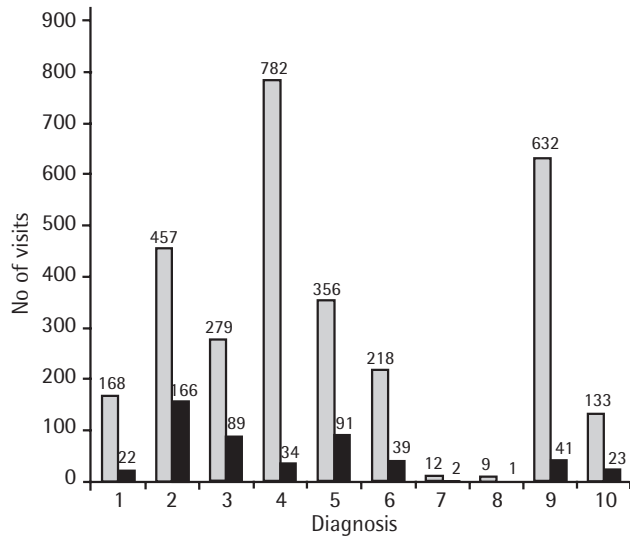


Figure 1 Number of emergency visits (gray bars) and hospitalizations (black bars) in relationship with the psychiatric diagnosis (ICD-9-CM). 1) Organic Psychoses (290 to 294). 2) Schizophrenic disorders, paranoid conditions and other non-organic p. (295,297 and 298). 3) Affective psychosis (296). 4) Neurotic disorders (300). 5) Personality disorders (301). 6) Toxic dependence and abuse (303 to 305). 7) Eating behavior disorders (307.1 and 307.5). 8) Sleep disorders (307.4). 9) Acute reactions to stress and adaptation (308 and 309). 10) Other disorders.

Origin

In relationship to the origin population, the percentages of patients visited per number of inhabitants of each population were between 0.4% and 3.1%. There were 5 populations out of the 27 populations studied in which no patients were attended (all of them less than 700 inhabitants) (fig. 2).

Seasonability and diagnosis

In reference to the seasonability of the conditions seen, two large diagnostic groups show statistically significant differences in relationship to the number of visits according to the season of the year. The schizophrenic type psychotic pictures were attended more frequently in winter while the neurotic type pictures were attended more in spring/summer.

In relationship with the affective psychosis, there is a mild increase in the number of visits during the summer of 2003 and 2004. In the year 2005, the cases seen in summer and fall become the same.

Meteorology and psychiatric care

The following comparison of all the meteorological parameters studied acquire statistical significance: mean temperature (TMED)/no. of daily visits ($p=0.005$), maximum tem-



Figure 2 Percentage of visits generated by the populations of the zone studied. It is seen that the central zone of the region generates a greater relative number of visits.

perature (TMAX)/no. of daily visits ($p = 0.007$) and minimum temperature (TMIN)/no. of daily visits ($p = 0.004$). The Spearman analysis shows that both the correlation both for TMIG and for TMAX and TMIN with the number of visits per day is positive and statistically significant.

The relationship between humidity (HUM) and daily visits is statistically significant ($p = 0.033$), but in a non-linear way ($p = 0.02$).

When we studied the wind parameters, wind direction and atmospheric pressure, the comparisons did not have statistical significance.

The relationship between temperature and visits per day is linear, the number of visits increasing as the environmental temperature increases.

The linearity mentioned was verified with the statistic test in this sense included in the procedures of ANOVA of the SPSS.

Solar radiation

In regards to affective disorders, solar radiation is less on those days of the visits (249): 171.5 W/m^2 regarding those in which there are no visits (846): 179.6 W/m^2 . However, this difference is far from being statistically significant ($p = 0.235$) or from contributing to the variability ($\text{Eta}^2 = 0.001$). In the other conditions, there is no relationship between the number of visits, by diagnostic groups, and intensity of solar radiation.

Based on the results we need to make the following considerations:

- When we compared the age of the patients visited with other national reviews, the data overlap⁴. The same does not occur regarding gender, male patients predominating in other studies (2:1)⁴. There is also a clear parity in our sample, more in agreement with works such as those of García Carretero (1989)^{6,22}.
- We give special attention to the number of patient attendance and its relationship with the environmental temperature, regardless of whether they condition or not an admission. We observed that on the days when 0 to 6 patients were attended, mean temperature was not about $17.2 \text{ }^\circ\text{C}$ (maximum of $22.3 \text{ }^\circ\text{C}$ and minimum of $12.7 \text{ }^\circ\text{C}$), while the days in which there were more than 6 visits corresponded to mean temperatures of $20 \text{ }^\circ\text{C}$ (maximum of $25.5 \text{ }^\circ\text{C}$ and minimum of $15.4 \text{ }^\circ\text{C}$). No clear variations in temperature were detected with the 0 to 5 visit group. The critical value to consider would be mean temperatures greater than $15.5 \text{ }^\circ\text{C}$ since the thermic increases above these values are accompanied by a clear increase in the number of visits (from 5 to 9), this being a linear increase (the greater the temperature the greater the number of visits) after $15.5 \text{ }^\circ\text{C}$. In our case, the days in which no psychiatric emergency was attended corresponded to days with very low environmental temperatures. Our results, in this sense, coincide with those observed in the work of Santiago et al.²¹
- Although the following was not the primary objective of this work, the relationship between the environmental temperature and number of visits generated by the different diagnostic groups studied were evaluated generally. In our series, we detected an ascending tendency from the beginning of the summer (that continued to increase until the month of November) in the number of admissions due to manic episodes (ICD-9-CM criteria: 296.0, 296.1 and 296.4), reaching its maximum period in that period. This coincides with many works that relate the affective disorders with seasonality^{9,20,23-25}. Thus, it corroborates the results obtained by Madalena and Del Porto²⁴, who state that the index of admission due to mania has a relationship with temperature and those of Hare and Walter²⁶, who describe an increase in admissions due to manic episodes in the summer.
- On the other hand, lack of daytime light and low temperatures have been related with the development of depressive pictures in winter^{9,20,27}, a higher number of visits due to depressive disorders (ICD-9-CM criteria 296.2, 296.3 and 296.5) having been detected in our population in the second half of the year with some increase in the months of winter regarding those of the summer. The results of the different studies consulted do not always agree since authors such as Salib and Sharp do not find any relationship between the hospitalization of patients with affective disorders and variations of daytime temperature and hours of sun in the days prior to the admission²⁸.
- In regards to the admission of schizophrenic patients and their relationship with temperature, our results differ with those of other authors. The number of admissions of schizophrenic patients has been linked in some studies to increase in temperature^{29,30}, regardless of the season of the year. In one of them, Shiloh et al., concluded that the mean rates of monthly admissions of patient with schizophrenia correlate with the maximum mean monthly environment temperature ($R = 0.35$)³⁰. For others, such as Shapira et al., the admissions of schizophrenic patients reached their maximum in summer²⁵. We have found that the psychotic pictures – schizophrenia and affective psychosis (that accounted for 24.2% of the visits and 49.2% of the admissions), were seen more frequently in winter. If we only analyze the schizophrenia (ICD-9-CM criteria: 295), the result is a mild predominance in winter, along the same line as Gómez González who associates the attendance to this type of pictures with low temperatures ($6\text{--}20 \text{ }^\circ\text{C}$)⁴.
- As we have been able to see, the neurotic pictures, stress and adaptation disorders, accounted for 46.4% of the visits and only 6.8% of the admissions, these being seen more frequently in spring and summer. For other authors

such as Hare and Walter (1978), the group of neuroses showed little seasonability, the increase in visits responding more to social factors²⁶. San Gil et al., (1988) concluded that anxiety disorders do not significantly depend on the meteorological situation^{15,18}.

- In the 9 cases (6 men and 3 women), evaluated as sleep disorders (ICD-9-CM criteria: 307.4) the temperatures on the day of the visit were extreme (low or high), corresponding to seasons of winter and summer.
- Solar radiation was significantly higher on the days with 7 or more visits than on the other days, probably due to the close relationship of this variable with temperature. In this same sense, Gómez González (1998) describes a mild increase of admissions during the days with more hours of sun (without specifying diseases), the predominant season of the year being summer⁴.
- We have not found any substantial variations in the number of patient attendance in relationship with the environmental pressure, and have not been able to corroborate the conclusions of Schory et al., who found a marked relationship between acts of violence and psychiatric emergencies with low atmospheric pressures⁵.
- We consider very accurate the work of Maes, de Meyer et al. Its suggests that fluctuations of the atmospheric activity in the previous days could be related with psychopathological alterations that occur weeks after³¹. In our evaluation, we have only considered the meteorological data corresponding to the day of the visit but we consider that it would be of interest that future studies would also consider the meteorological values of the previous days, which could be a limitation of our current study.
- We should accept that the results we have observed regarding the influence of the wind in the number of emergency psychiatric visits have not responded to that expected. Works such as those of Sulman³² on the influence of the winds in the desert (in Israel) and their relationship with certain psychiatric alterations or the different studies mentioned by Larcan et al. (1974)³³ that verify the correlation between the Föhn wind (in Central Europe) and suicides, have stressed this union and are supported in our setting by a deep-rooted popular belief, especially in windy zones (Canary Islands, Catalonia, etc.). We believe that we should mention a recent study of Bulbena et al. (2005) on 3,000 persons who, during the year 2002, were seen in the emergency psychiatric department of a Barcelona site, that related the dry and hot, wind of the wind with the risk of suffering anxiety attack in prone persons, the study concluding that said phenomenon triples the risk of suffering them³⁴. In our study, we have tried to find a relationship between speed and direction of the wind (wind of west component: wind from the southwest and west) and the visits made. Although this relationship occurs, we consider that the higher number of attendance on days of wind of the west component may be explained by the fact that it is the dominant wind in the zone, present in 66% of the days of the period studied. Breaking it down by diseases, we have found that 63.5% of the pictures diagnosed as «Acute reactions to stress and adaptation» (ICD-9-CM criteria: 308 and 309) and 69.8% of the «neurotic disorders» (ICD-9-CM criteria: 300) were seen on days when the wind had a west component (202.5° to 292.5°) as well as 65.7% of the «personality disorders» (ICD-9-CM 301). The «psychosis» (ICD-9-CM 290 to 296) visited on days of southwest or west wind accounted for 66.3% of the total seen in the 3 years studied. We cannot make any comments regarding the influence of the north wind (from 324° to 71°) described in other works³¹ as we have not detected this type of wind on any day of those studied.
- Some works mention an inverse relationship between relative humidity in the previous week and admissions due to affective disorders, so that during the most humid weeks, there are fewer admissions for this type of disorder²⁸. On the contrary, in our case, we have detected more admissions due to this disorder on days with greater relative humidity, there being 20% more visits due to affective psychosis on these days than during the driest days.
- Another subject to take into account would be that bioclimatic factors are less relevant in the industrialized urban areas than in the country³⁶. It should be stated that in our zone, there are no large differences of exposure to the open sky among those who live in the rural area and the urban one since most of the former spend a large part of the day in the city and sleep in their rural residence (frequently conditioned with artificial conditioning). Thus, the difference should be, in principle, less marked, although it may be the object of future works. When the residence sites of the patients studied were reviewed, no differences were found between the percentage of visits per number of inhabitants in the populations of less than 5,000 inhabitants (1.45%), basically rural, and those having a more urban character (1.58%).
- Other factors besides the meteorological ones that have been shown to have an influence on the different number of patients coming to the emergency departments, already mentioned by other authors¹⁵, should not be overlooked. These may be vacation periods, holidays, long weekends, social events of great impact (periods of economic crisis, natural tragedies, etc.). It also must not be overlooked that bad weather may be, in itself, an obstacle to coming to the medical visit.
- We coincide on this with García Carretero et al. (1986) who have already pointed out a multifactorial character so that if a series of factors coincide in time and space, they would be capable of precipitating a certain disease in meteorosensitive persons⁶. We also coincide with San Gil et al. (1988) who stressed the importance of

studying «type of weather» and not the isolated variables in this type of research¹⁹.

- In any case, it seems to be important to conduct studies with correct stratification of the sensitive groups (age, gender, rural or urban setting), fully coinciding with Bulbena et al., about the need to propose studies by diagnostic groups³⁴. On the other hand, the possibility of geographic variations that could explain some differences in the results of similar works is also accepted.

CONCLUSIONS

In our study, the relationship between the increase of environmental temperature and increase in number of emergencies was manifested. Our results coincide, in this sense, with those of different national studies (García Carretero⁶, San Gil^{2,18} and Gómez Gonzalez⁴) and with those presented by the Santiago et al. group²¹.

Association of the degree of humidity and number of daily visits attended in the emergency department is supported by the conclusions of some works in which an increase in the number of visits during the drier days is perceived^{18,21}. In our study, this relationship was also statistically significant, but not linear. Thus, we consider that it would not be an ideal marker to facilitate a more adequate distribution of the care resources in the emergency departments.

Regarding the rest of the variables analyzed, we found no statistically significant differences. We did not find a positive relationship between low pressures and number of patients attended to, as Schori et al. point out⁵. Our results also do not coincide with those presented by García Carretero et al.^{6,22} regarding the significant relationships with wind and precipitations. On the other hand, they coincide with those presented by Santiago et al.²¹, who also found no association between wind and hospitalizations.

Finally, we would like to mention the direct and linear relationship between temperature and number of psychiatric admissions in our zone as conclusion of the greatest interest in our study since we consider that mean temperatures over 15.5 °C could act as predictor of the increase of care pressure and thus its knowledge could permit a more rational distribution of health care resources.

It would be interesting to perform future prospective studies to verify the predictive value of demand for emergency visits that an expected temperature would have, according to the weather forecast reports in the zone.

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