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Impact of the summer 2003 heat wave on the activity of two psychiatric emergency departments

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Introducción. Heat waves (HW) have been related with lethal effects, especially in Europe during the intensely hot summer of 2003. However, besides increased deaths and ailments, there are no specific data on the psychiatric effects of heat waves.

Methods. We have compared psychiatric emergencies in Barcelona during a 15-day HW period with the rest of the 2003 summer days. The main variables of the study were total emergencies, admissions, diagnoses, Severity of Psychiatric Illness scale (SPI), psychosocial variables, treatment rendered (including use of restraints), and referrals.

Results. No differences were found in the number of emergencies and admissions. During the Heat Wave, there were more patients with psychiatric backgrounds, more diagnoses of alcohol and drug abuse, but fewer anxiety disorders. The proportion of patients with mechanical restraint increased, but this only occurred in half of the cases in patients with drug or alcohol abuse. The item «dangerousness toward others» (part of the SPI scale) scored significantly higher during the heat waves.

Conclusions. There were no significant increases or decreases in psychiatric emergencies or admissions. However, the heat wave was related to more violent behavior and higher drug and alcohol abuse. It should be noted that anxiety conditions and benzodiazepine prescriptions were lower during this period. These findings may be useful to implement medical-psychiatric preventive measures against the heat wave phenomenon.

Key words:
Heat wave. Psychiatry. Emergencies. Violence. Anxiety. Alcohol abuse. Meteorology. Severity scale.

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Impacto de la ola de calor del verano 2003 en la actividad de dos servicios de urgencias psiquiátricas

Introducción. La ola de calor se ha relacionado con efectos letales, especialmente en Europa durante el caluroso verano de 2003. Pero aparte del incremento de muertes y enfermedades, no existen datos específicos de los efectos psiquiátricos de la ola de calor.

Metodología: Se compararon las urgencias psiquiátricas de dos hospitales de Barcelona durante los 15 días de la ola de calor con el resto del verano de 2003. Las principales variables del estudio fueron: urgencias totales, ingresos, diagnósticos, gravedad, variables psicosociales, tratamientos aplicados (incluyendo contención mecánica), y derivaciones.

Resultados: No se encontraron diferencias en el número de urgencias ni de ingresos. Durante la ola de calor, hubo más pacientes con antecedentes psiquiátricos, más diagnóstico de abuso de alcohol y drogas, pero menos trastornos de ansiedad. También aumentó la proporción de pacientes con sujeción mecánica, pero sólo en la mitad de casos, esto ocurrió en pacientes con abuso de alcohol o drogas. El ítem «peligro hacia los demás» de la escala de gravedad se puntuó significativamente más alto en la ola de calor.

Conclusiones. No hubo incrementos o disminuciones significativas en urgencias o los ingresos psiquiátricos, aunque los que acudieron tenían más antecedentes psiquiátricos. Durante la ola de calor hubo un cierto incremento significativo de violencia y de abuso de alcohol y drogas, pero menor porcentaje de trastornos de ansiedad y menos prescripciones de benzodiazepinas durante este período. Estos datos exploratorios indican el interés de considerar medidas preventivas médicopsiquiátricas frente al fenómeno de la ola de calor.

Palabras clave:
Ola de calor. Psiquiatría. Urgencias. Violencia. Ansiedad. Abuso de alcohol. Meteorología. Escala de gravedad.

INTRODUCTION

Extreme climate conditions during the summer months pose an important threat to public health. There have been many reports over the last 20 years on the health effects of the heat wave in different areas of the world such as Asia, Europe and the United States.[1] The most recent and dramatic heat wave occurred in Europe during the warm summer of 2003. Mortality increased in several countries such as France, England and Spain during that time.[2]

However, there is little information on the possible effects of the heat wave regarding psychiatric disease. The references found in the literature have focused on mortality and suicide. Bark[3] found a greater risk of mortality in psychiatric patients compared with the general population during a heat wave in the city of New York. In regards to suicide, Barker et al.[4] found a modest correlation between climatic variables and parasuicide, but only in women. Deisnhammer et al.,[5] in Austria, found that the risk of suicide was significantly greater in days with high temperatures, low relative humidity and during electrical storms.

Several studies have identified greater use of violent methods of suicide when the temperatures and sunlight are more intense. Lambert et al.[6] found that the suicide incidence had its nadir in winter and its zenith in spring and summer, showing some parallelism with the hours of sunlight. This was clearer in the case of violent suicide.

Violent behavior has been related occasionally with high temperatures. Anderson, who was a pioneer in establishing relationships between heat and aggressivity, pointed out that the relationship between temperature and criminal activity was greater for violent cases than for non-violent crime.[7] Flannery and Penk found a statistically greater number of aggressions towards the ward staff during the hottest months.[8] However, Schory et al.[9] did not find any relationship between violence and high temperature. However, they did find more violence when there were low barometric pressures.

In regards to psychiatric emergencies, San Gil et al.[10] found an inverse relationship in the Canary Islands between the total number of emergencies and temperature. Another more recent article on psychiatric emergencies and climatic conditions showed more panic episodes with west winds (warm wind that originates in the west), less frequency of panic during rainfall and somewhat more in fall than in other seasons.[11,12]

The results of many of the studies on psychiatric emergencies and climate have been unequal, probably due, on the one hand, to the lack of specificity in the diagnosis (e.g. when only the global number of emergencies are studies) and, on the other, to the complexity of the climatic variants. Finally, regarding emergencies due to alcohol and drug problems, the Drug Addict Information System of Barcelona shows clear increases during June and September in the last ten years.[13]

Because of the great impact that the 2003 heat wave had on health and the scarceness of the data on the psychiatric effects, it was decided to analyze the repercussions of the heat wave on the psychiatric emergencies in two hospitals of Barcelona during that period. Two objectives were defined for this purpose: that of *a)* comparing the number of psychiatric emergencies and psychiatric admissions during the days of the heat wave (HW) compared to the rest of the summer of 2003 (N-HW) and *b)* evaluating the clinical and demographical differences of the psychiatric emergencies between the days with HW and the non-HW days.

SUBJECTS AND METHODS

Meteorological data were obtained from the closest observatory to the area of the Hospital del Mar which was provided by the Catalonia Meteorology Service. The variables used in this study were maximum, minimum and mean temperatures. Although there is no single definition for heat wave, some authors[14] define it as the presence of maximum temperatures above 32ºC for more than 3 days. In Europe, 2003 was the hottest year of the last 53 in terms of minimum, maximum and mean temperatures and in terms of duration. In Barcelona, the exact period of heat wave was from August 2nd to the 15th (figure 1). This was studied by Trejo et al. in regards to mortality in a study taken here as reference[14]. However, given the seasonal variation of psychiatric emergencies, it was decided to compare this period with the rest of the summer and not with previous years. By doing so, it was aimed to avoid the usual variation between one year and another.

All of the psychiatric emergencies attended during the summer of 2003 (from June 21 to September 20 in a General Hospital [Hospital del Mar] and in a Psychiatric Hospital [Institut Municipal Psiquiatria]) were included in this study. These two hospitals covered approximately 40% of the psychiatric emergencies of the city.

Other variables were also included: age, gender, psychiatric disease severity (PDS), which is a 12 items scale validated in Spanish[15] used to measure psychiatric severity that offers a predictive value for admissions. Other variables were background of psychiatric disease, background of admissions, contact was psychiatric departments, case referral, time of stay in the city, if they were accompanied by someone during the admission, drug treatment during the admission and drug treatment prescribed. Information was obtained from the medical and psychiatric reports of the reports of all the cases attended. DSM-IV diagnoses after the psychiatric evaluation were classified into 10 groups: alcohol abuse disorders, schizophrenia, affective disorders, delusional disorders, anxiety disorders, personality disorders, disorders due to

Table 1 Comparison of the number of psychiatric emergencies and admissions in two public hospitals during the HW and non-HW days (summer of 2003) in Barcelona

	Heat wave	Non-heat wave		
IMPU	Days (n = 14)	Days (n = 79)	t	p
(Psychiatric Hospital)	Mean	Mean		
Daily emergencies	10.07	12.08	1.64	0.10
Emergencies (men)	4.14	5.63	1.90	0.06
Emergencies (women)	5.92	6.45	0.70	0.48
Daily hospital admissions	2.78	3.52	1.31	0.19
Admissions (men)	1.57	1.89	0.76	0.44
Admissions (women)	1.21	1.63	1.18	0.23
Hospital del Mar (General Hospital)				
Daily emergencies	8.92	9.59	0.65	0.51
Emergencies (men)	4.64	4.73	0.13	0.89
Emergencies (women)	4.28	4.98	0.87	0.38
Daily hospital admissions	1.93	1.79	0.33	0.74
Admissions (men)	0.93	1.03	0.37	0.69
Admissions (women)	1.16	0.73	1.62	0.11

use of sedatives or opiate-sedatives, cocaine or stimulant use disorders, adaptive disorders and a miscellaneous group. Other variables such as mechanical restraint, medical consultation between specialties and complementary examinations while the patients were in the psychiatric emergency ward were also collected.

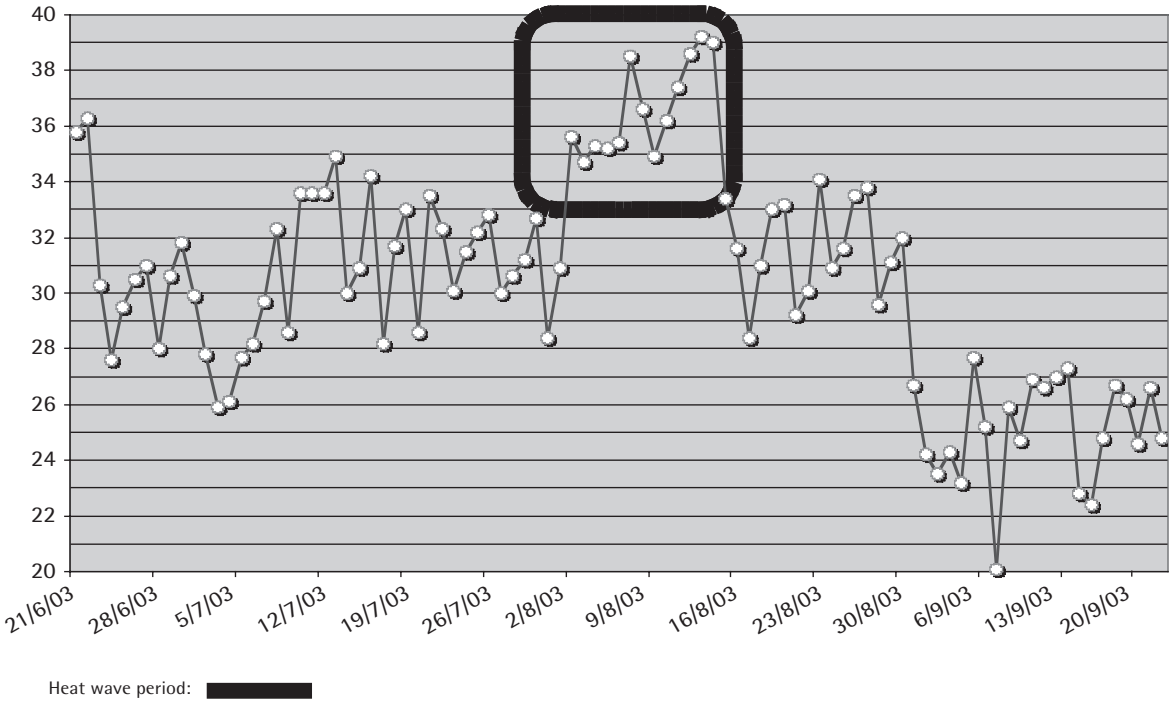

Figure 1 *Maximum Temperatures in Barcelona during the summer of 2003. Heat wave period.*

In order to verify the hypothesis that some variables differed between the period of the Heat Wave (HW) from the rest of the days of the summer (N-HW), the data were processed according to the variables included. Pearson's Chi Squared test (χ^2) was applied in the contingency tables to analyze the relationship between the two qualitative variables. The Student's T test and the ANOVA were used to determine the relationship between the categorical variable with the two or three levels, respectively, and a quantitative variable with a normal distribution. No correction was applied for the multiple comparisons because of the exploratory analysis design used. The *Odds Ratio* (OR) of the prevalences were calculated using logistic regression techniques, with the corresponding calculation of the confidence intervals.[16] Data management and statistical analysis were conducted using the SPSS (11.0) and JMP (5.1.1) programs for Macintosh.

RESULTS

The HW period lasted 14 days, while the rest of the 2003 summer included 79 days. In the HW days, the Psychiatric Emergency Department of the Hospital del Mar attended 125 patients and there were 27 admissions. On the contrary, during the N-HW, 747 patients were attended and there were 140 admissions. On its part, the Psychiatry Institute received 141 visits and had 39 admissions during the HW days and 946 visits with 272 admissions during the N-HW days. No differences were found between the HW days and N-HW days in either of the two hospitals studied when the average number of emergencies and admissions per day were compared between the two periods.

Regarding the second objective, that is, the more detailed comparative clinical study, the sample was obtained from the Hospital del Mar since the information included more variables and greater amplitude of somatic data. Among the patients attended during the HW and non-HW days, there were no significant differences in age or gender. Regarding psychiatric backgrounds and previous contact with psychiatric departments, there were slight, but significant differences: greater proportion of patients seen during the HW had been in contact with the psychiatric departments (62.6% *vs.* 52.3%, *Odds Ratio* [95% CI] = 1.66 [1.12-2.44]; p = 0.011) and also a greater proportion had psychiatric backgrounds compared to those attended outside of the heat wave period (90.3% *vs.* 75.9%, *Odds Ratio* [95% CI] = 2.94 [1.58-5.55]; p = 0.0004). On the contrary, no differences were found regarding the presence of companions between the HW and non-HW days. Regarding medication taken before the visit to the emergency department, there were also no differences, except for «other psychotropic drugs» (fundamentally mood stabilizers and drugs for alcohol and drug abuse), which were slightly more common in patients of the HW, specifically 4.84% of the patients with HW and 1.88% of patients with Non-HW (p = 0.043). A total of 32% of the patients attended during the HW and 35.8% of those in the Non-HW period did not take any medication (*Odds Ratio* [95% CI] = 0.85 [0.56-1.27]; p = 0.41).

Comparison of the DSM-IV diagnoses only achieved significant differences regarding a greater proportion of alcohol abuse disorders in the group attended in the HW, but there were fewer anxiety disorders (table 2).

The 12 items of the psychiatric disease severity scale were compared between the HW and non-HW. A higher score was only found in the item «dangerousness toward others» on the HW days. Other items such as substance abuse, medical symptoms and the level of premorbid dysfunction scored higher in the HW group, although without significance (table 3). The mean number of immigrants per day and mean number of vagrants per day showed no sig-

Table 2 Comparison of the grouped diagnoses during the heat wave and non-heat wave days

	Heat wave (n = 125)	Non-heat wave (n = 747)			
Grouped Diagnoses of the DSM-IV	% of patients	% of patients	*Odds ratio*	95 % CI	p
1 Alcohol	11.4	5.8	2.12	1.12-4.01	0.01
2 Schizophrenia	13.8	12.9	1.09	0.63-1.91	0.75
3 Affective disorders	13.8	16.3	0.83	0.48-1.44	0.50
4 Delusional disorders	9.8	6.9	1.48	0.76-2.87	0.24
5 Anxiety disorders	15.4	19.4	0.47	0.25-0.89	0.001
6 Personality disorders	16.3	13.6	1.25	0.74-2.10	0.40
7 Sedatives/Opiates	4.1	1.5	2.79	0.95-8.17	0.051
8 Cocaine/stimulants	4.9	3.9	1.29	0.52-3.19	0.57
9 Adaptive disorders	5.7	11.6	0.47	0.24-1.04	0.056
10 Others	4.9	8.4	0.67	0.28-1.60	0.36

nificant differences, although there was a lower proportion during the HW days. Given that Barcelona is a very popular city for tourists and visitors, the time that the persons attended stayed in Barcelona was also evaluated. No differences were found between both periods in terms of visitors or subjects who lived prominently in the city. Thus, a «tourist effect» during a HW period was ruled out. The subjects who had remained in Barcelona for a period of less than 30 days accounted for 4% of all the patients attended during the HW and 5.5% of those attended during the non-HW period (*Odds Ratio* [95% CI] = 0.72 [0.28-1.85]; p = 0.48). The subjects who had lived in the city for more than one year accounted for 92.8% of the patients during the HW days and 91.5% during the non-HW days (*Odds Ratio* [95% CI] = 1.19 [0.58-2.46], p = 0.63).

Regarding the intervention in emergency wards, the use of mechanical restraint, time of stay in the emergency ward, occupation of the psychiatric observation boxes and drug treatment prescribed were compared (table 4).

It was observed that there was a greater proportional use of mechanical restraint during the HW days, so that the percentage of subjects in each period who had mechanical restraint was also compared. A total of 15.2% of the subjects from the HW period, but only 9.1% of those from the non-HW period, had to be restrained (*Odds Ratio* [95% CI] = 1.78 [1.03-3.09]; p= 0.03). It was also analyzed in the patients with mechanical restraint had taken drugs or had drunk before the admission. It was found that only half of the patients who received restraint had drunk alcohol or taken drugs before coming to the psychiatric emergency ward.

Drug prescription was significantly different for anxiolytics, other psychotropic drugs and other medications. Anxiolytics were prescribed significantly less during the HW. This agrees with the lower percentage of diagnosis between the group of patients of the HW. Regarding «other psychotropic drugs» there were more in the HW period, although some patients were taking medications of more than one group. In seven cases, mood stabilizers were indicated (lithium, lamotrigine, carbamazepine and valproic acid), and six other cases received medications related with alcohol (cyamamide, disfulfiram, hemineurin and acamprosate). In four cases, medication related with opiates was prescribed (methadone and dextropropoxiphen) and five patients took miscellaneous medications (topiramate, gabapentin, biperidene, propanolol). A significantly higher amount of prescription of other non-psychiatric drugs in the HW was also found, all of them derivatives of Vitamin B.

In relationship to the complementary tests conducted, there were no differences in the number of blood analyses between groups and a non-significant tendency towards more requests for analyses on the presence of toxic substances only appeared in the HW group (5.64% during the HW vs 2.81 during the non-HW; *Odds Ratio* [95% CI]: 2.05 [0.85-4.93]).

Finally, the recommended referral of the subjects did not show any significant difference between the subjects attended during the HW and those attended during the non-HW, except for a significantly larger proportion of patients sent to a drug addict center during the HW period (table 5).

Table 3 Comparison of the Psychiatric Disease Severity Scale Items between heat wave and non-heat wave days

Psychiatric disease severity	Heat wave days (n = 14)	Non-heat wave days (n = 79)		
Item	Mean	Mean	t	p
Suicide potential	0.44	0.47	0.38	0.7
Dangerousness toward others	0.69	0.41	3.05	0.003
Psychiatric symptoms severity	1.74	1.72	0.13	0.98
Current self-care level	0.95	0.98	0.2	0.8
Medical disease	0.72	0.58	1.19	0.23
Alcohol and substance abuse	0.96	0.79	1.40	0.16
Professional problems	0.85	0.78	0.52	0.60
Family problems	1.21	1.22	0.05	0.91
Instability at home	0.45	0.59	0.98	0.32
Resistance to treatment	0.65	0.62	0.26	0.79
Family involvement	0.66	0.79	1.1	0.27
Premorbid dysfunction	1.31	1.14	1.55	0.12
Total PDG	10.55	9.98	1.05	0.30

Table 4 Comparison of treatment in the emergency ward between HW and non-HW

	Heat wave Days (n = 14)	Non-heat wave Days (n = 79)			
Activities in the emegency ward	Mean	Mean		t	p
Use of mechanical restraint	1.36	0.86		2.16	0.038
Hours in emergency ward	27.53	35.11		1.25	0.19
Use of observation boxes	3.28	3.25		0.06	0.83
	Heat wave (n = 125)	**Non-heat wave (n = 747)**			
	% of patients	% of patients	*Odds ratio*	95 % CI	p
Application of mechanical restraint	15.2	9.1	1.78	1.03-3.09	
Pharmacological treatment					
Non-pharmacological treatment	50	41.87	1.37	0.94-2.01	0.10
Anxiolytics	19.35	29.39	0.57	0.36-0.92	0.01
Antidepressants	10.48	10.6	0.98	0.58-1.82	0.95
Antipsychotics	10.48	15.3	0.64	0.35-1.18	0.15
Other psychotropics	5.64	1.88	3.11	1.23-7.86	0.01
Other non-psych. drugs	4.03	0.94	4.40	1.38-14.10	0.006

DISCUSSION

On the contrary to the Siloh et al. study that found some increase of admissions in patients with schizophrenia when high temperatures persisted,[17] there were no significant differences in the number of emergencies or in the admissions between the HW and Non-HW days in the present study. However, there are important differences in methods and objectives between the two studies since these authors applied correlations (monthly means of temperature and admissions) while our study directly compares variables between two periods.

Although not many significant differences were observed between the cases attended in the HW and outside of it, some findings should be considered. First, the subjects attended during the HW had more psychiatric backgrounds and a higher percentage of active and past contact with the psychiatry departments. This could reflect greater vulnerability that helps in the reappearance of episodes in some patients during the HW. Bipolar subjects and alcoholics would probably be more vulnerable if we consider the medication prescribed because there was a significantly greater amount of prescriptions of mood stabilizers and drugs for the treatment of alcoholism and drug addicts during the

Table 5 Comparison of the treatment recommendations prescribed in the emergency ward between the heat wave and non-heat wave days

	Heat wave (n = 125)	Non-heat wave (n = 747)			
Recomendaciones prescritas	% of patients	% of patients	*Odds ratio*	95 % CI	p
None	3.2	1.2	2.71	0.82-8.94	0.08
Hospitalization	20.2	19.3	1.05	0.65-1.68	0.84
Mental health care	39.2	37.1	1.12	0.76-1.66	0.55
Drug centers	10.4	4.5	2.43	1.25-4.75	0.007
Social services	0.81	2.4	0.33	0.04-2.47	0.26
Primary care	8.1	9.1	0.87	0.43-1.74	0.68
Others	11.3	12.2	0.91	0.50-1.65	0.71

HW. Although not necessary related to the HW, it is known that bipolar patients are especially sensitive to situations of higher temperature or more solar radiation.[18] On the other hand, there are basic research data that show that heat produces changes in the lymphocyte function,[19] in the somatosensory evoked potentials and in the EEG.[20] Studies with humans tend to confirm the presence of some deterioration in the psychological functioning as the temperature increases. Tanaka et al.[21] found deterioration in several psychological tasks (digit sum test) under different conditions of temperature increase. Sharma et al.[22] also found that all the mental tasks evaluated were adversely affected under extreme heat and also observed a significant decrease in performance at real temperatures of 32.2º C and 33.3º C under humid and dry heat, respectively. They conduced that the conditions of greater humidity with the same temperature (elevated) deteriorate performance more. This is a relevant fact to study because Barcelona has a high level of humidity, which thus could affect the most vulnerable subjects.

In the second place, the diagnostic profile in HW includes fewer anxiety disorders but more alcohol and abuse and sedative disorders. One reason could be that the heat wave reduces the precipitation of anxiety or the likelihood of a patient asking for help for anxiety. Some indirect evidence could support these conclusions. De Graaf et al.[23] conducted an extensive study in Holland on the seasonal variations in the prevalence of mental disorders in the general population surveys and found that panic disorder and generalized anxiety disorder were more frequently observed in winter than in other seasons. In another study with more than 2000 children and adolescents that used the analysis of epidemiological study data found clear annual variations in the presentation of symptoms in anxiety disorders, separation anxiety disorders, social phobia and depressive disorders with his stimulation of the nadir between August and October.[24]

In the third place, the present study finds that HW seems to cause some increase in the emergencies associated to drug and alcohol consumption. These conclusions support the yearly reports and articles of the city of Barcelona that show a significant increase in emergencies due to alcohol or drugs during the summer.[12] In a recent study in North East Europe, Silm and Ahas[25] found that the upper peak of the problems associated with the greater consumption of beer occurs in summer from June to August and that the lower peak occurs during the first months of the year, values that coincide with the Scottish data which also found high consumption of alcoholic drinks in the summer.[26] Other pictures related with alcohol such as the incidence of alcoholic psychosis[27] and alcoholic pancreatitis[28] are also more common in summer.

Interestingly, and in the fourth place, there are no differences in suicide symptoms. However, the item of the SPI, "dangerousness toward others," was significantly elevated among the subjects attended during the heat wave. These data as well as those of greater use of mechanical restraint point towards more agitated and aggressive behaviors during the HW. This would coincide with the positive relationship between high temperatures and aggressive behavior. The patients attended during the HW showed both substance abuse as well as increased aggressivity, which is a recognized association.[29] On the other hand, the potentiating effect of high temperatures on the effects of some psychodrugs such as MDMA is also known.[30]

However, not all the aggressive behavior identified in the group of patients attended during the HW can be attributed to alcohol and drug abuse. In fact, only half of the patients who received mechanical restraint during the HW had taken substances before being seen in the emergency department. Thus, temperature and substance abuse seems to play a role independently of the violence of the HW.

Some limitations of the study merit consideration here. First, the size of the accumulated sample during the index period is small. Although all the cases were collected precisely during the 14 days of the heat wave, the numbers obtained are relatively small to be able to strictly generalize the results obtained. Second, the control period included the rest of the summer and this is an arbitrary chronological criterion. In any event, this period was chosen because it provides a global view of the summer and thus it can be a valid period that can be used to be compared with the index period. In the third place, only the patients attended in the psychiatric emergencies of the general hospital were included in the qualitative analysis. This was due to the parallel interest in this somatic aspect of the patients. The study of all the psychiatric emergencies of the city could have been of much interest, however, there were no unified databases. The zones chosen are representative and similar in regards to mental health outpatient facilities, although the predominant district in the Hospital del Mar generally recorded a higher frequency of emergency visit (15.6 per one thousand inhabitants *vs* 10.5 per one thousand inhabitants in other districts). This could cause a moderate inclusion bias. The fourth important limitation comes from the retrospective design of the study, which therefore, depends on a secondary source. In this regards, it could be stated that the validity and reliability of the information were closely controlled and that all the cases and controls were reviewed to some length with the research team. Finally, the applied statistics did not include complex predictive models or time series, since the objective was to conduct the exploratory study of the phenomenon. There is no doubt that new studies are needed with perspective designs to confirm the tentative findings of the present study, which is, in reality, a first approach to the unexplored psychiatric medical phenomenon that may be associated to the Heat Wave phenomenon.

If, as it seems, heat waves are becoming more frequent with the worldwide climate change, it will be necessary to

generalize the primary and secondary prevention programs during the heat wave periods. In this study, a presumed vulnerability of some psychiatric patients and, in the second place, some psychiatric effects whose knowledge may be useful in said preventive programs, can be discerned.

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