

The effect of air-conditioning (AC) on intrahospital mortality during the 2003 heat wave in Mainland Portugal

Baltazar Nunes, Eleonora Paixão, Carlos Matias Dias, Paulo Nogueira e José Marinho Falcão
Department of Epidemiology, National Institute of Health Dr. Ricardo Jorge



BACKGROUND

The August 2003 heat wave accounted for an excess of more than 1900 deaths in Portugal.
At the European level it is acknowledged that this heat wave was responsible for an excess of about 70000 deaths.
In both situations a considerable number of deaths seem to have occurred in hospitals

OBJECTIVE

The aim of this study was to evaluate the association between the existence of AC in wards and the intrahospital mortality rate during the 2003 heat wave in Portugal mainland.

MATERIAL AND METHODS

Study Design

A historic cohort design was used, including all patients aged 45 or more, hospitalized during the last 7 days before the beginning of 2003's heat wave, and, therefore exposed to excess heat only in hospital.
The study endpoint was the survival of patients in the 18 days of the heat wave plus two days. This endpoint was compared between patients in wards with air-conditioning (AC+) against patients in wards without air-conditioning (AC-).

The cohort Study Group (SG) included all patients admitted between 22.07.2003 to 28.07.2003 before the beginning of the heat wave and were not discharged before 30.07.2003.
The Comparison Group (CG) included patients belonging to 4 sub-cohorts admitted to hospital during the winter and spring of 2003, defined in order to be as independent as possible in time from each other.

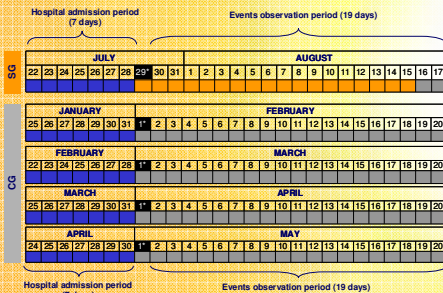


Figure 1 - Description of the cohort defined as study group (SG) and the 4 sub-cohorts defined as the comparison group (CG)
*All patients were hospitalized, at least, one day during the exposure period. Orange color indicates the period of the heat wave - 29.07 - 15.08.2003

Data

Data was obtained from the National Hospital Discharge Database (ACSS, Health Ministry).
Information on the air-conditioning existence was obtained by a survey of hospital administrations during 2007.

Statistical analysis

The association between the survival of patients and being hospitalized in AC+ wards was assessed with a Cox regression model that has included the covariates sex, age, hospital region, type of wards, and main diagnosis at discharge as potential confounders.

RESULTS

The study encompassed 41 (48%) hospitals of Portugal mainland belonging to National Health Service (NHS) and 2093 patients (54%) in the SG.
In SG 30,2% of patients were in AC+. These percentage were higher in men (32,2%) than in women (28,3%), being the difference almost statistically significant. Significant differences were found between patients hospitalized in AC+ versus AC- wards, concerning the distributions by age groups, region, main diagnosis and type of wards (table 1).
In CG 30,0% of patients were in AC+ (30,6% men; 29,4% women). Distributions by region, main diagnosis and type of wards showed a significant differences (table 1).

CONCLUSIONS

The study found evidence that, during the heat wave of 2003, the patients admitted in participating wards with air-conditioning were associated to a survival increase. That association was probably casual. The risk reduction of death was estimated in 40%.
These results support the recommendations issued by the Portuguese Heat Wave Contingency Plan.

Table 1: Percentual distribution for patients in AC+ wards versus patients in AC- wards, by gender, age groups, region, main diagnosis and type of wards

	Study Group			Comparison Group					
	Patients in participant wards AC- %	Patients in participant wards AC+ %	p*	Patients in participant wards AC- %	Patients in participant wards AC+ %	p**			
	n = 1460	n = 633		n = 6236	n = 2668				
Gender	Male	48,7	0,051	48,3	49,7	0,238			
	Female	51,3		51,7	50,3				
Age groups	45 - 54	16,1	0,018	16,8	16,6	0,599			
	55 - 64	18		19,6	18,9				
	65 - 74	29,6		23,1	30				
	75 - 84	26,2		29,5	25,6				
	≥85	10,1		10	9,5				
Region	North	46,6	<0,001	47	26,3	<0,001			
	Center	41,8		63	64,2				
	LVT+Alentejo+Algarve	11,6		9,5	9,5				
Main diagnosis	Neoplasms	18,2	0,005	17	16,6	<0,001			
	Diseases of circulatory system	17,8		22,4	15,9				
	Diseases of respiratory system	12		10,1	14				
	Diseases of digestive system	12,4		14,6	13,8				
	External causes	10,2		12,6	8,5				
	Others	29,4		22,7	30,8				
	Type of wards	Internal Medicine		32,7	<0,001		28	27	<0,001
		Surgery		21,5			30	23,2	
		Orthopedics		10,2			11,8	12,1	
		Neurology		4,6			3,9	4	
Oncology		3,8	3,8	4					
Urology		4,9	5,7	5,2					
Other		22,3	16,9	23,4					

*χ² Pearson test for the comparison between patients in AC+ wards and patients in AC- wards, in SG.
**χ² Pearson test for the comparison between patients in AC+ wards and patients in AC- wards, in CG.

The hazard ratio (HR) of death for patients in AC+ wards versus patients in AC- wards was 0,60 (table 2).
The study indicates that patients hospitalized in a ward AC+ were protected from the heat excess effect with a 40% (95%CI: 3%-63%) risk reduction of death, result obtained after adjustment by the covariates.
According with these results, for SG, figure 2, shows that survival for patients in AC+ wards was higher than for patients in AC- wards. In figure 3, it can be observed the overlapping of the survival curves for patients in AC+ and AC- wards in the CG.
It should be noticed that in SG significant associations were found between survival and the following characteristics: 75-84 age group (HR=3,52; 95%CI:1,58-7,84), ≥85 age group (HR=2,68; 95%CI:1,09-6,61) using 45-54 age group as reference; internal medicine ward (HR=4,61; 95%CI:1,16-18,32) using orthopedic ward as reference.

Table 2: Hazard ratios of death for patients in AC+ wards versus patients in AC- wards, obtained by a Cox regression model after adjustment

	Deaths /1000 persons.day	Mortality ratio	CI 95%	Hazard ratio	CI 95%	P*
SG	AC+	5,8	0,64	[0,40-1,01]	0,60	[0,37-0,97]
	AC-	9,08				
CG	AC+	6,5	1,10	[0,89-1,36]	[0,84-1,32]	0,644
	AC-	5,9				

* Wald test for parameters significance

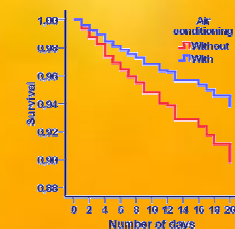


Figure 2: Study Group (SG): survival during the observation period of the patients hospitalized in AC+ and AC- after adjusting for the confounding variables (Cox regression).

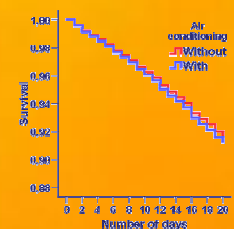


Figure 3: Comparison Group (CG): survival during the observation period of the patients hospitalized in AC+ and AC- after adjusting for the confounding variables (Cox regression).

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Acknowledgements

C. H. Caldeira da Rocha, C. H. Vale do Sousa, C. H. de Coimbra, C. H. Vila Nova de Gaia, H. D. Aguiar, H. D. Alcobaça, H. D. Amarante, H. D. Barcelos, H. D. Beja, H. D. Braga, H. D. Cantanhede, H. D. Castelo Branco, H. D. Chaves, H. D. Covilhã, H. D. Évora, H. D. Estarreja, H. D. Faro, H. D. Figueira da Foz, H. D. Fundão, H. D. Guarda, H. D. Guimarães, H. D. Leiria, H. D. Matosinhos, H. D. Macedo de Cavaleiros, H. D. Mandel, H. D. Peniche, H. D. Pombal, H. D. Portalegre, H. D. Portimão, H. D. Póvoa do Varzim, H. D. Santo Tirso, H. D. São João da Madeira, H. D. Tondela, H. D. Valongo, H. D. Viana do Castelo, H. D. Vila Nova Famalicão, H. D. Viseu, H. Santo António, H. Universidade Coimbra, Hospital da Feira, Hospital de Santa Maria, Hospital de São João, Hospital Joaquim Urbano, Hospital São Marcos, Inst. P. Oncologia Coimbra, Inst. P. Oncologia Porto