JORNADA

Calidad del Aire en España:
Nuevos Retos

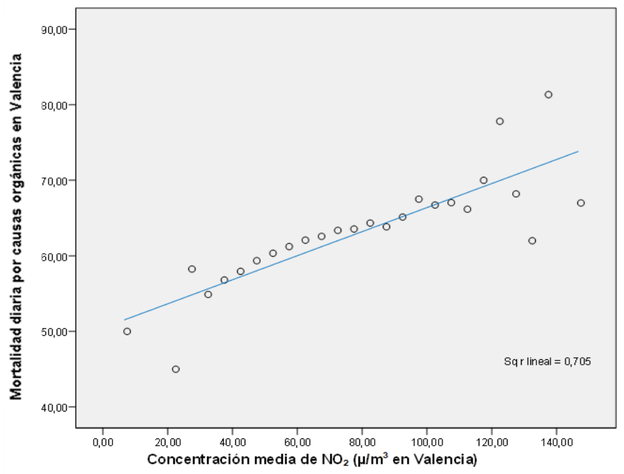
Incidencia de la contaminación atmosférica a corto plazo sobre la morbimortalidad en España

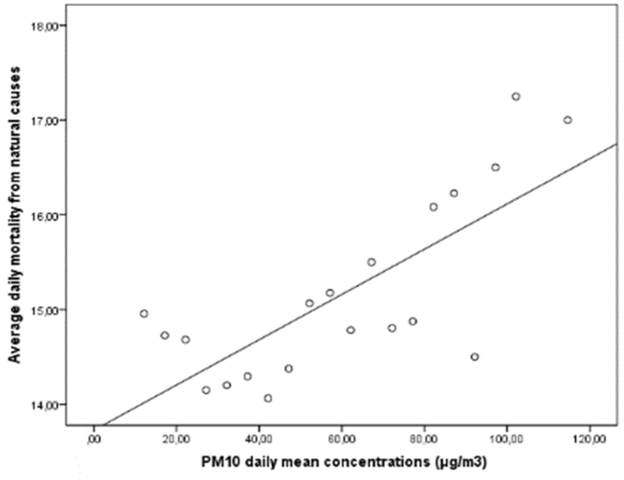
Dr. Julio Díaz Jiménez

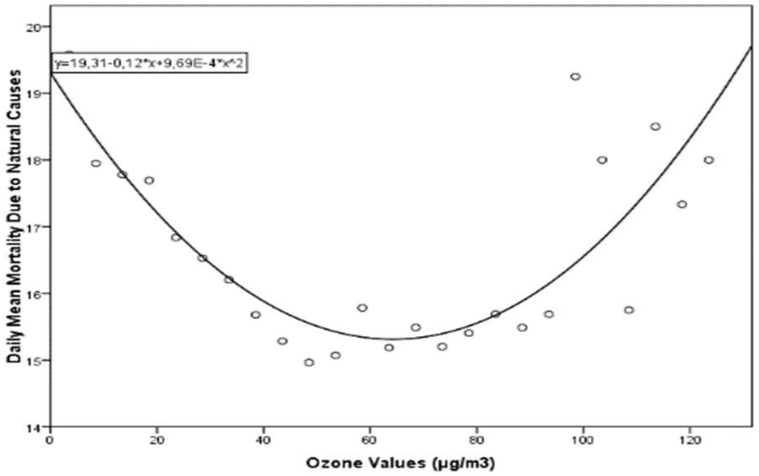
1. Introducción:

1. Efectos a corto plazo. Retrasos entre 0-15 días.

2. Relaciones funcionales Mortalidad-Contaminación







3. Mecanismos biológicos muy similares.

- Inflamación sistémica
- Oxidación celular.
- En partículas además un mecanismo mecánico.
- Peligrosidad en aumento al disminuir el tamaño de las PM y en función desu composición

2. Impacto de la contaminación atmosférica sobre la mortalidad.

Basados en funciones dósis-respuesta calculados para cada lugar.

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Evaluation of short-term mortality attributable to particulate matter pollution in Spain

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ABSTRACT

According to the WHO, 3 million deaths are attributable to air pollution due to particulate matter (PM) world-wide. However, there are no specific updated studies which calculate short-term PM-related cause specific mortality in Spain. The objective is to quantify the relative risks (RRs) and attributable risks (ARs) of daily mortality associated with PM_{10} concentrations, registered in Spanish provinces and to calculate the number of PM-related deaths. We calculated daily mortality due to natural (ICD-10: A00 R99), circulatory (ICD-10: I00 I99) and respiratory causes (ICD-10: J00 J98) for each province across the period 2000–2009. Mean daily concentrations of PM_{10}, NO_2 and O_3 was used. For the estimate of RRs and ARs, we used generalised linear models with a Poisson link. A meta-analysis was used to estimate RRs and ARs in the provinces with statically significant results. The overall RRs obtained for these provinces, corresponding to increases of 10 $\mu g/m^3$ in PM_{10} concentrations were 1.009 (95% CI: 1.006 1011) for natural, 1.026 (95% CI: 1.019 1033) for respiratory, and 1.009 (95% CI: 1.006 1012) for circulatory-cause mortality. This amounted to an annual overall total of 2683 deaths (95% CI: 852 4354) due to natural, 651 (95% CI: 359 1026) due to respiratory, and 556 (95% CI: 116 1012) due to circulatory causes, with 90% of this mortality lying below the WHO guideline values. This study provides an updated estimate of the effect had by this type of pollutant on causes of mortality, and constitutes an important basis for reinforcing public health measures.

1. Introduction

Particulate matter (PM) consists of a complex mix of solid and liquid particles of organic and inorganic substances suspended in the air. The main components of PM are sulphates, nitrates, ammonium, sodium chloride, "black carbon", mineral dust, organic matter and water (Querol et al., 2012). The respirable particles, PM_{10} (aerodynamic diameter of less than 10 microns) and $PM_{2.5}$ (aerodynamic diameter of less than 2.5 microns), are the types of PM which have the greatest health impact (WHO, 2013). According to a recent WHO study (WHO, 2016), in 2012 some 3 million deaths world-wide were estimated to be attributable to PM-related air pollution, with 193,000 of these occurring in Europe and 7000 in Spain.

The health effects of PM are especially well documented, with a distinction being drawn between two types of effects, short- and long-term. Cohort studies designed to detect the long-term effects on population health, link exposure to PM to an increased risk of death (Dockery et al., 1993; Pope et al., 1995; Miller et al., 2007; Beelen et al., 2008a; Ostro et al., 2010), even for very low $PM_{2.5}$ concentrations (Crouse et al., 2012). Although the principal causes of mortality associated with long-term exposure to PM are some types of cancer (Beelen et al., 2008b), recently the International Agency for Research on Cancer (IARC) classified $PM_{2.5}$ as a carcinogen (Loomis et al., 2013); equally notable are its effects on cardiovascular (Brook et al., 2010; Dominici et al., 2006) and respiratory causes (Dominici et al., 2006; Guaita et al., 2011; Kim et al., 2012), with clearly established physiopathological mechanisms (Brook et al., 2010; Rückerl et al., 2011). Recent studies suggest other types of health outcomes, in which PM is associated with other types of diseases (Rückerl et al., 2011). Hence, PM has been found to have an effect on diabetes (Brook et al., 2008), neurological development in children (Freire et al., 2010) and neurological disorders in adults (Ranft et al., 2009).

There are also numerous studies which associate short-term exposure to PM –both PM_{10} and $PM_{2.5}$- with morbidity and

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CONTAMINACIÓN ›

La contaminación ha matado a 93.000 personas en España en una década

Investigadores de la Escuela Nacional de Sanidad ponen cifras al impacto de las emisiones de los coches en las ciudades

MANUEL ANSEDE

22 JUN 2018 - 10:55 CEST

Un panel luminoso en la M-30 indica la activación del protocolo anticontaminación en Madrid. VÍCTOR SAINZ

IN ENGLISH

Pollution has killed 93,000 people in Spain in the last decade

"Hay que restringir el tráfico", sentencia la bióloga Cristina Linares, investigadora de la Escuela Nacional de Sanidad, en Madrid. No es una propuesta, sino un llamamiento desesperado a la acción. El equipo de Linares acaba de calcular que la contaminación atmosférica ha provocado la muerte prematura de unas 93.000 personas en España a lo largo de una década. Son los primeros estudios con datos de todas las provincias españolas.

2. Impacto de la contaminación atmosférica sobre la mortalidad (2000-2009).

	Naturales (IC 95%)	Respiratorias (IC 95%)	Circulatorias (IC 95%)
PM10	2683 (852 4354)	651 (358 1026)	556 (116 1012)
NO2	6085 (3371 9180)	997 (460 1524)	1977 (828 3197)
O3	499 (277 717)	126 (54 194)	167 (39 292)
Total	9267 (4500 14251)	1774 (872 2747)	2700 (983 4501)

Mortalidad anual tabaco: Aproximadamente 60.000
Mortalidad anual accidentes tráfico en 2023: 1.145

NO_2 1,8% / PM 1% / O_3 0,2%


MORTALIDAD
CÁNCER DE PULMÓN, MAMA Y OTROS
AFECTACIÓN ENFERMEDADES NEURODEGENERATIVAS
ENFERMEDADES CARDIOVASCULARES Y RESPIRATORIAS
DIABETES Y OBESIDAD
NACIMIENTOS PREMATUROS Y BAJO PESO
PROBLEMAS DE DESARROLLO COGNITIVO NIÑOS. ANSIEDAD Y DEPRESIÓN ADULTOS
OTRAS PATOLOGÍAS, SÍNTOMAS Y MOLESTIAS
EFECTOS ADVERSOS PARA LA SALUD
POBLACIÓN AFECTADA
FUENTE: CRISTINA LINARES Y JULIO DÍAZ, INSTITUTO DE SALUD CARLOS III.

3. Cambio Patrón Morbilidad –Contaminación en España

International Journal of Environmental Health Research
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**Short-term effect of $PM_{2.5}$ on daily hospital admissions in Madrid (
2005)**

Cristina Linares [a]; Julio Díaz [b]
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Instituto de Salud Carlos III, Escuela Nacional de Sanidad, Madrid, Spain

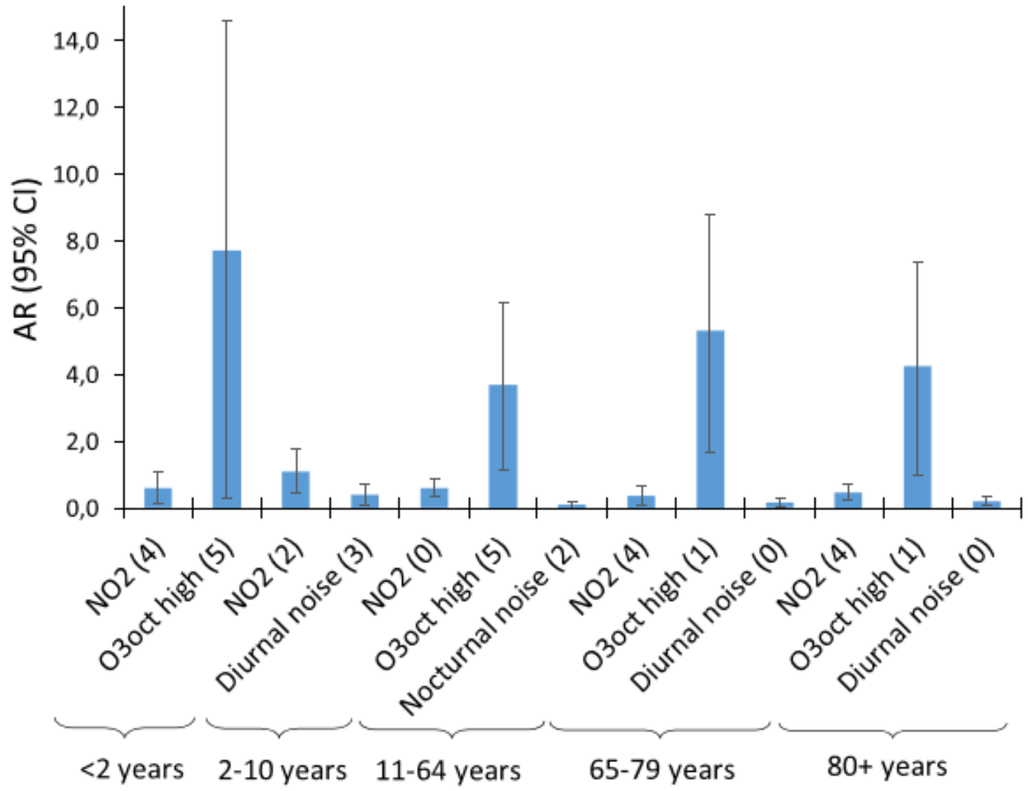
First published on: 18 February 2010

Table 4. Relative risk and attributable risk of hospital admission, by age group and specific cause, for each 25 grain/m^3 increase in the concentration of each pollinic species.

	All causes	Circulatory	Respiratory
All ages	$PM_{2.5}$ (0) RR: 1.07 (1.05 1.09) AR: 6.7%	$PM_{2.5}$ (0) RR: 1.08 (1.03 1.13) AR: 7.5%	$PM_{2.5}$ (0) RR: 1.07 (1.02 1.11) AR: 6.3%
	T_{cold} (6) RR: 1.00 (1.00 1.01) AR: 0.3%	Leqday (0) RR: 1.08 (1.05 1.11) AR: 7.8%	O_3A (7,8) RR: 2.85 (2.23 3.46) AR: 59.5%
	Gramineae (2) RR: 1.03 (1.00 1.05) AR: 2.6%	T_{cold} (2,9) RR: 1.02 (1.01 1.03) AR: 1.7%	T_{hot} (2) RR: 1.04 (1.03 1.06) AR: 4.1%
	Oleaceae (6) RR: 1.01 (1.00 1.02) AR: 0.9%	*Platanaceae* (5) RR: 1.01 (1.00 1.01) AR: 0.7%	*Gramineae* (4) RR: 1.08 (1.02 1.14) AR: 7.2%
	Platanaceae (5) RR: 1.00 (1.00 1.01) AR: 0.3%		

Increases in pollutants refer to increases of 25 $\mu g/m^3$. In the case of ozone, the increase is 25 $\mu g/m^3$ over the daily mean threshold of 65 $\mu g/m^3$. In the case of temperature, T_{cold} refers to each °C below 30°C, and T_{hot} to each °C above 30°C.

3. Cambio Patrón Morbilidad en España. Estudios en Madrid.



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journal homepage: www.elsevier.com/locate/envres

Short–term effects of air pollution and noise on emergency hospital admissions in Madrid and economic assessment

R. Ruiz-Páez [a], J. Díaz [b,*], J.A. López-Bueno [c], C. Asensio [d], M.S. Ascaso [b], M. Saez [e,f], M.Y. Luna [g], M.A. Barceló [e,f], M.A. Navas [b], C. Linares [b]

3. Cambio Patrón Morbilidad en España. Estudios en Madrid.

Admissions per year attributable to pollutant.

	Mean annual attributable admissions (95% CI)	Mean annual admissions on WHO threshold being exceeded (95% CI)	% attributable admissions
Natural-cause admissions:			
NO_2 (lag 0)	5191 (2966–7412)	1503 (859–2146)	1.49%
NO_2 (lag 4)	3055 (1614–4493)	885 (467–1301)	0.88%
$O_{3\ oct\ high}$ (lag 1)	31 (11–51)	31 (11–51)	0.01%
$O_{3\ oct\ high}$ (lag 7)	24 (4–44)	24 (4–44)	0.01%
Diurnal noise (lag 0)	5685 (2533–8835)	–	1.63%
Respiratory-cause admissions:			
NO_2 (lag 0)	1427 (529–2321)	451 (167–734)	2.10%
NO_2 (lag 5)	1301 (702–1898)	411 (222–600)	1.92%
Diurnal noise (lag 0)	1987 (594–3378)	–	2.93%
Circulatory-cause admissions:			
$O_{3\ oct\ high}$ (lag 4)	13 (6–19)	13 (6–19)	0.02%
Diurnal noise (lag 0)	2432 (1257–3605)	–	4.47%

Mean annual admissions on WHO threshold being exceeded, was obtained by calculating the mean number of daily admissions that occurred on days on which the daily threshold value recommended by the WHO was exceeded (O_3: 100 μg/m^3, NO_2: 25 μg/m^3).

Table 5
Economic estimate per year.

	Total annual cost (€)	95% CI
Natural-cause admissions:		
NO_2 (lag 0)	€75 million	€43–108 million
NO_2 (lag 4)	€44 million	€23–65 million
$O_{3\ oct\ high}$ (lag 1)	€ 451,000	€160,000–741,000
$O_{3\ oct\ high}$ (lag 7)	€ 349,000	€58,100–640,000
Diurnal noise (lag 0)	€83 million	€37–128 million
Respiratory-cause admissions:		
NO_2 (lag 0)	€20 million	€8–33 million
NO_2 (lag 5)	€19 million	€10–27 million
Diurnal noise (lag 0)	€28 million	€9–48 million
Circulatory-cause admissions:		
$O_{3\ oct\ high}$ (lag 4)	186,000 €	€86,000–273,000
Diurnal noise (lag 0)	€35 million	€18–52 million

3. Cambio Patrón Morbilidad en España. Estudios en Madrid.

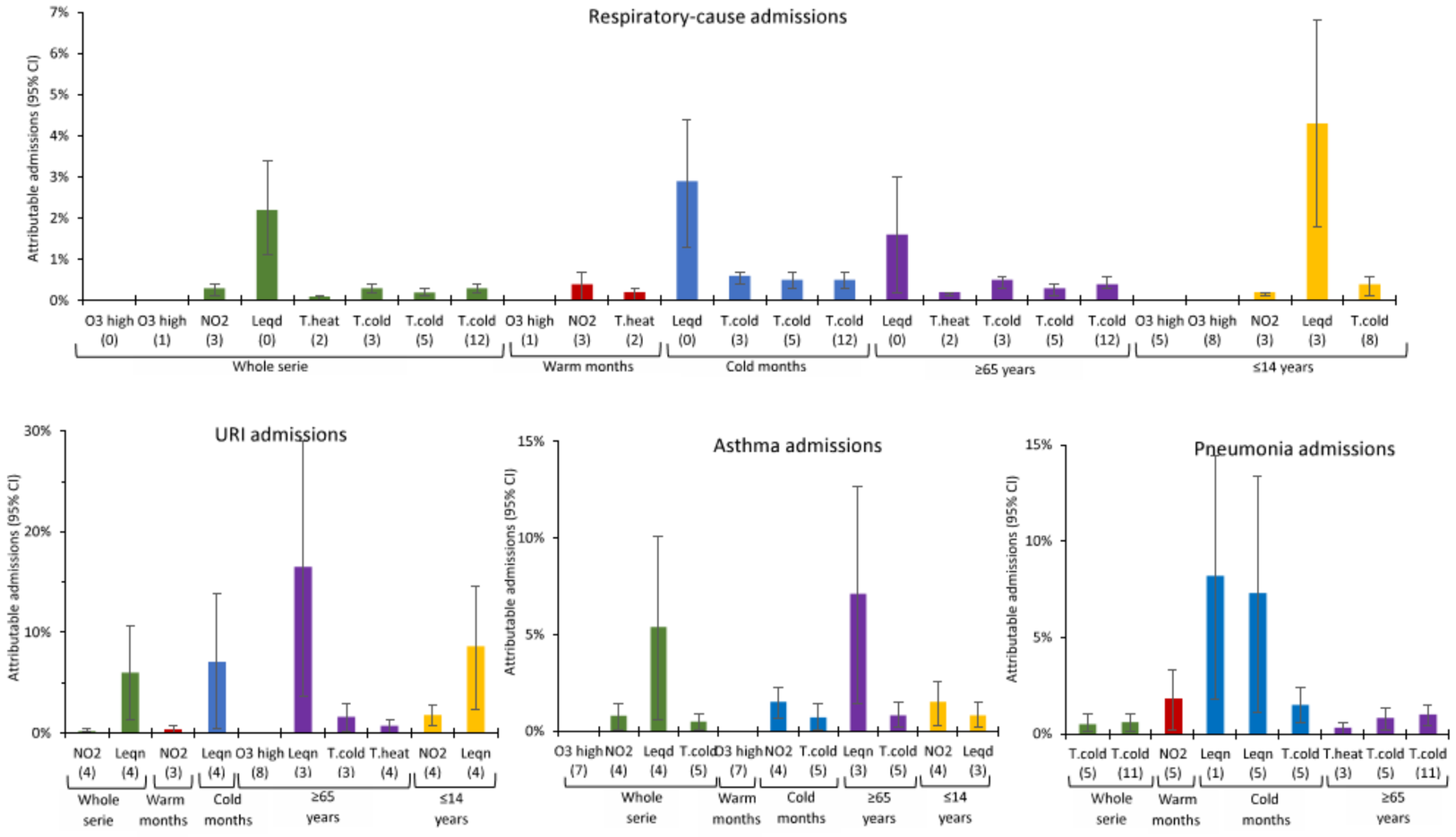


Figure 1. Percentage of attributable admissions with their respective 95% CIs for the significant independent variables in respiratory-cause admissions. Increases for every 10 µg/m³ above the 8-h ozone threshold of 107.5 µg/m³. Lags shown in brackets. Leqd: $L_{Aeq,7\text{-}23h}$, Leqn: $L_{Aeq,23\text{-}7h}$, Leq24: $L_{Aeq,24h}$. URTIs: Acute upper respiratory tract infections.

3. Cambio Patrón Morbilidad en España. Estudios en Madrid.

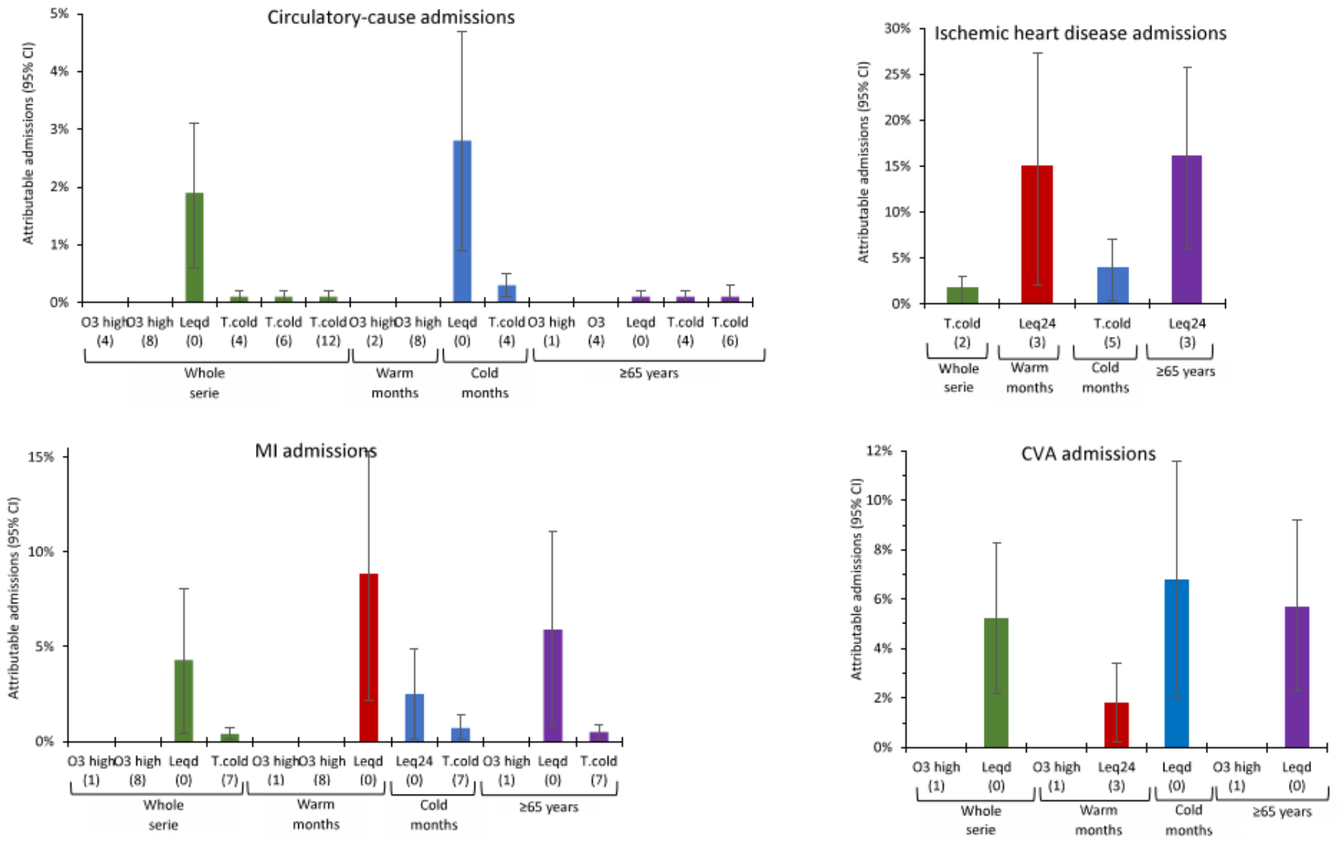


Figure 2. Percentage of attributable admissions with their respective 95% CIs for the significiant independent variables in circulatory-cause admissions. Increases for every 10 µg/m³ above the 8-h ozone threshold of 107.5 µg/m³. Lags shown in brackets. Leqd: $L_{Aeq,7\text{-}23h}$, Leqn: $L_{Aeq,23\text{-}7h}$, Leq24: $L_{Aeq,24h}$. MI: Acute myocardial infarction. ACVA: Acute cerebrovascular accident.

3. Cambio Patrón Morbilidad en España. Estudios en Barcelona y Valencia

Variable (retrasos)	Riesgo atribuible (%)	Ingresos atribuibles al año	% Ingresos atribuibles al año
NO2 (5)	0.58 (0.38 - 0.78)	5670 (3728 - 7607)	1.8 (1.2 - 2.5)
O3 (2)	0.20 (0.05 - 0.35)	2929 (696 - 5158)	0.9 (0.2 - 1.7)
Theat (4)	0.81 (0.26 - 1.35)	66 (21 - 110)	0.1 (0.0 - 0.1)
Tcold (7,11)	1.30 (0.31 - 2.29)	194 (47 - 342)	0.1 (0.0 - 0.2)

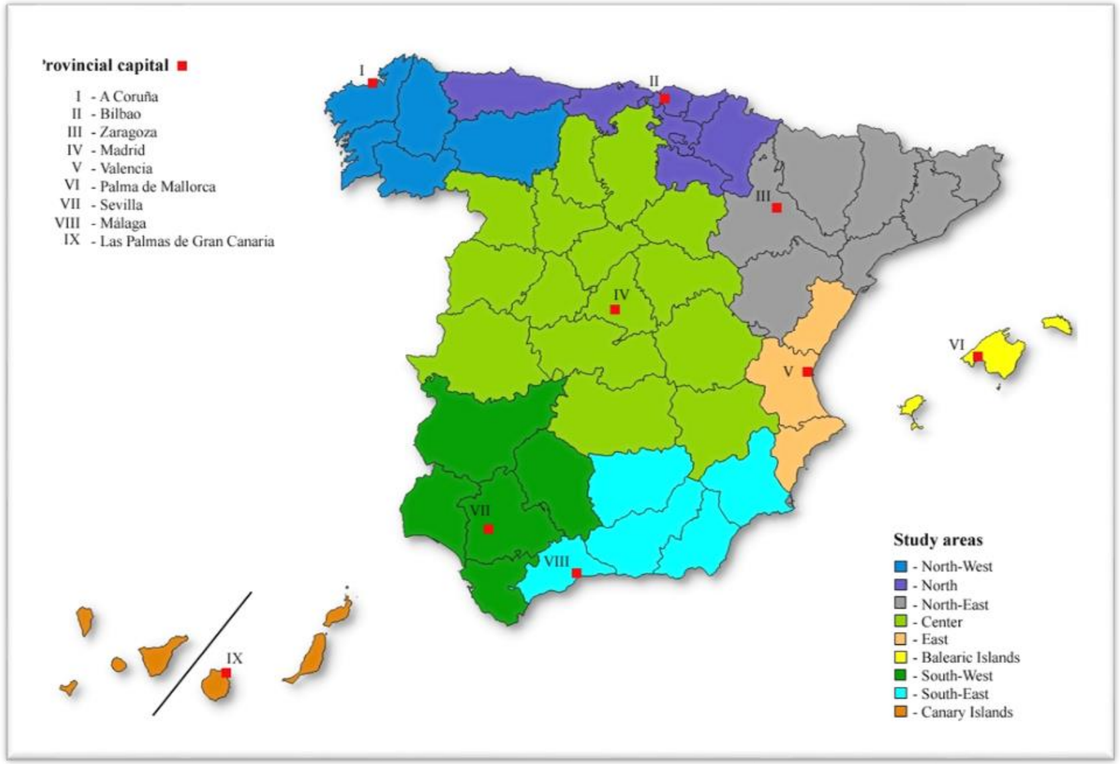
Efecto de la contaminación atmosférica sobre los ingresos urgentes en Barcelona (2013-2018)

Variable (retrasos)	Riesgo atribuible (%)	Ingresos atribuibles al año	% Ingresos atribuibles al año
NO2 (0, 5)	1.79 (0.96 - 2.61)	3989 (2126 - 5844)	3.0 (1.6 - 4.5)
O3 (1)	0.25 (0.01 - 0.49)	1956 (68 - 3840)	1.5 (0.1 - 3.0)
Tcold (4,11)	2.40 (1.54 - 3.23)	362 (232 - 491)	0. 6 (0.4 - 0.9)

Efecto de la contaminación atmosférica sobre los ingresos urgentes en Valencia (2013-2018)

4. Efectos combinados contaminación-temperatura:

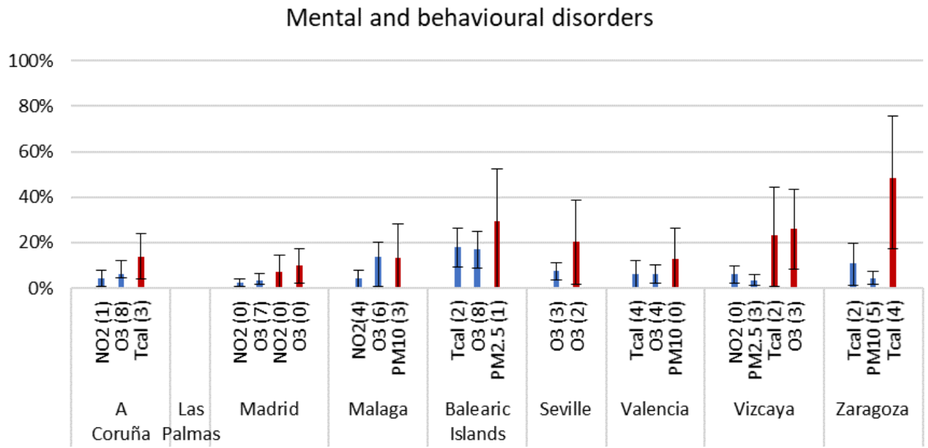
Incidencia de las advecciones de polvo del Sahara y de material particulado por combustion de biomasa en los ingresos urgentes por enfermadeades mentales y del comportamiento, ansiedad y depression.

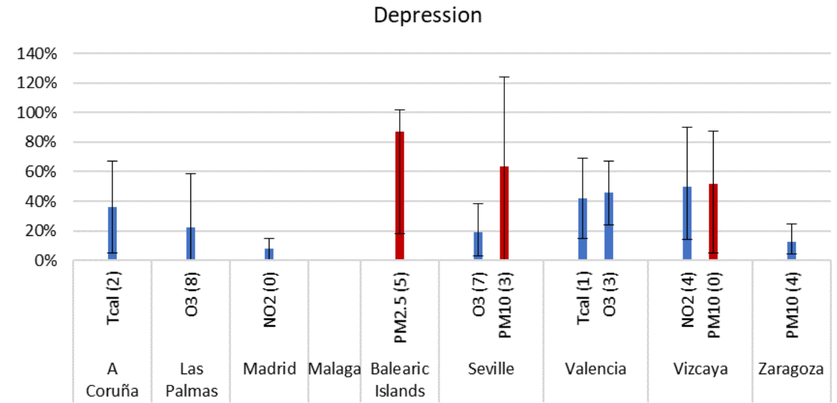


4. Efectos combinados contaminación-temperatura:

Incidencia de las advecciones de polvo del Sahara y de material particulado por combustion de biomasa en los ingresos urgentes por enfermadeades mentales y del comportamiento, ansiedad y depression.

a) Combustión de biomasa.



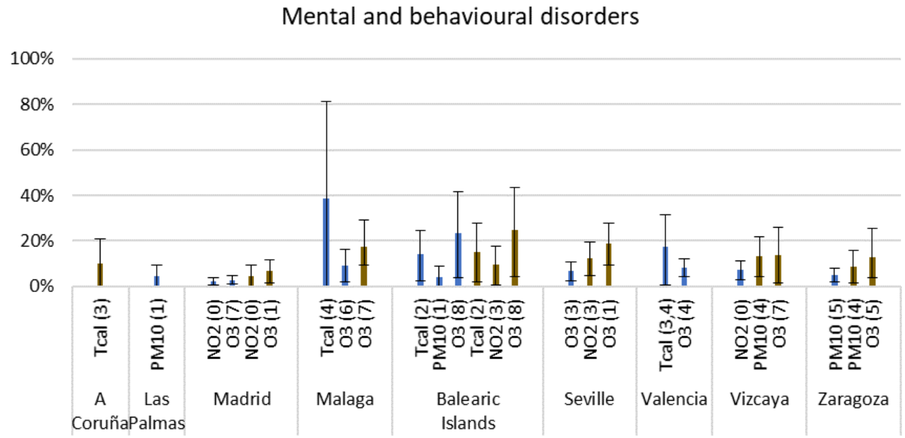


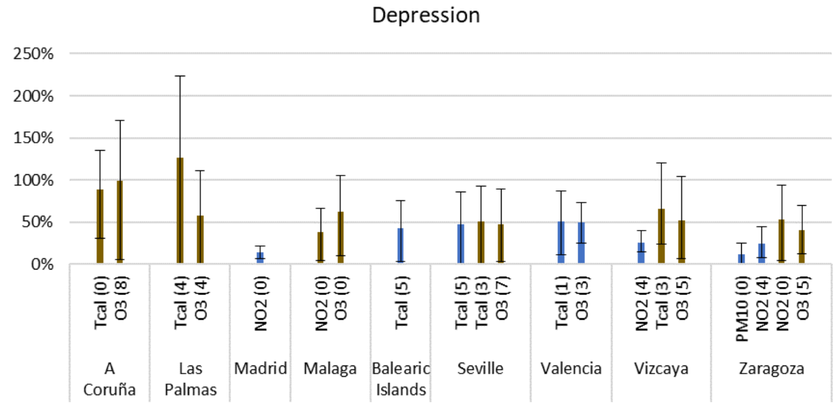
Percentage input of each of the independent variables to the emergency hospital admissions analysed due to the respective causes (shown in brackets, the lags at which associations occur). Shown in red, days with combustion =1; shown in blue, days with combustion=0.

5. Efectos combinados contaminación-temperatura:

Incidencia de las advecciones de polvo del Sahara y de material particulado por combustion de biomasa en los ingresos urgentes por enfermadeades mentales y del comportamiento, ansiedad y depression.

b) Advección polvo del Sahara.





Percentage input of each of the independent variables to the emergency hospital admissions analysed due to the respective causes (shown in brackets, the lags at which associations occur). Shown in brown, days with NAF =1; shown in blue, days with NAF=0.

6. Planes integradores.

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A new integrative perspective on early warning systems for health in the context of climate change

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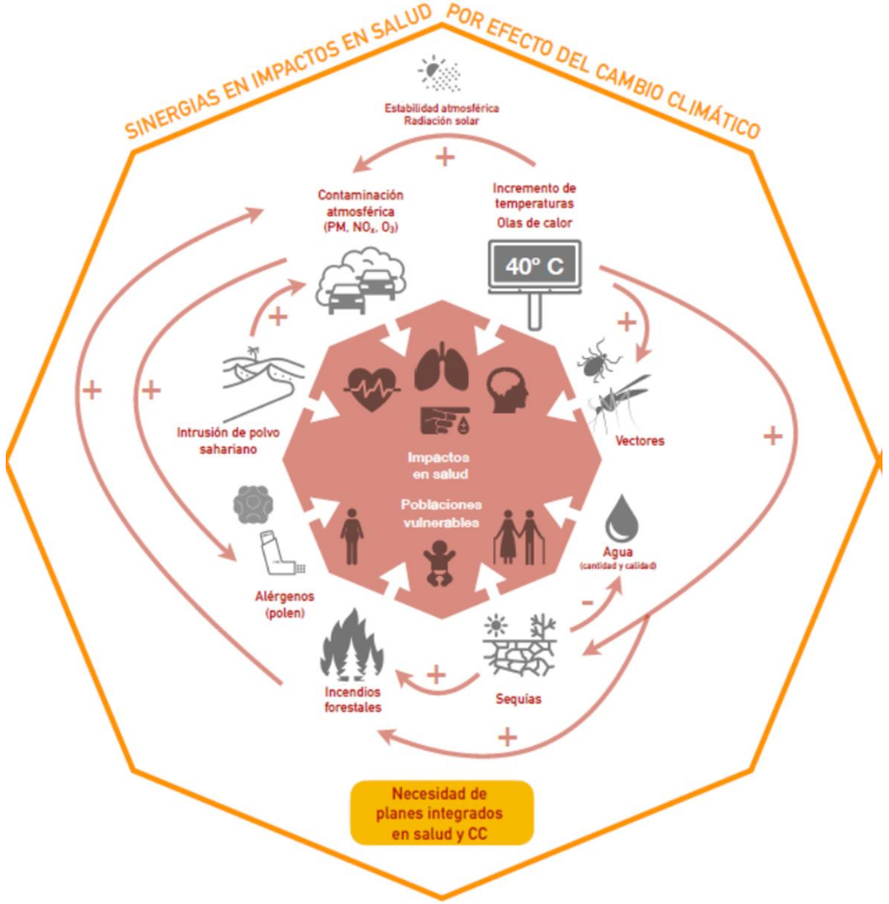

7. Conclusiones

1. El impacto en salud de la contaminación atmosférica va más alla de la mortalidad. Hay que estimar el coste económico de la contaminación debido a los ingresos urgentes a corto plazo.
2. Parece existir un cambio de patrón en el impacto los principales contaminantes en relación a su impacto en la morbilidad, al menos en las grandes ciudades.
3. Centrar el impacto en salud de los días con advección de polvo del Sahara o combustión de biomasa únicamente en las PM podría estar infraestimado su impacto real.
4. Es necesaria una visión integradora que tenga en cuenta los impactos conjuntos de todas las variables ambientales.