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COVID-19 and air pollution

Benoit Nemery, MD, PhD

Centrum Omgeving en Gezondheid

Departement Maatschappelijke Gezondheidszorg en Eerstelijnszorg

KU Leuven

Belgium

ben.nemery@kuleuven.be

KU LEUVEN

COVID-19 and air pollution ?

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1. Temporary improvements in air quality
2. Higher mortality in areas with higher air pollution?
3. Dispersion of SARS-CoV-2 via pollutant particles?

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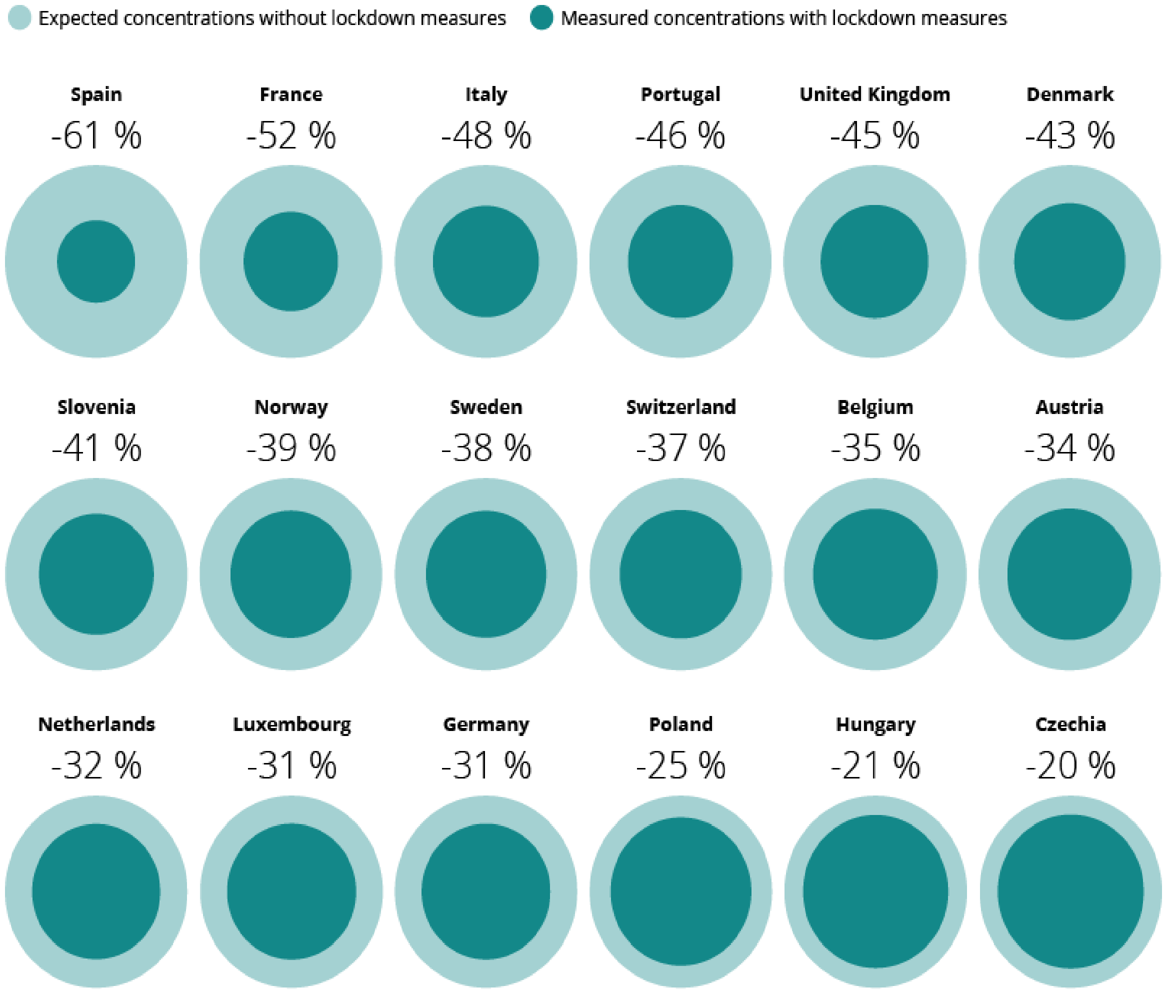
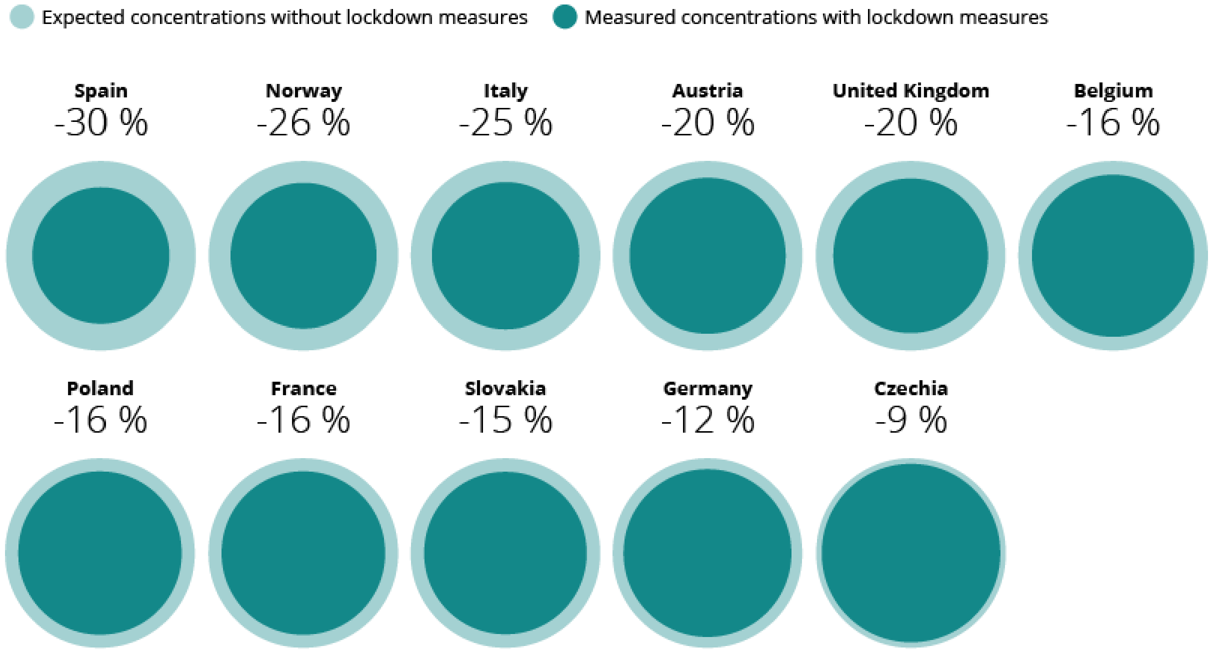
1. Temporary improvements in air quality during lockdown

Comparison between expected and actual NO_2 concentrations (selected countries, April 2020)



Comparison between expected and actual PM_{10} concentrations (selected countries, April 2020)



https://www.eea.europa.eu/post-corona-planet/covid-19-and-europes-environment

COVID-19 and air pollution

1. Temporary improvements in air quality
2. Higher mortality in areas with higher air pollution?
3. Dispersion of SARS-CoV-2 via pollutant particles?

2. Higher mortality in areas with higher air pollution ?

- Air pollution increases prevalence of at-risk subjects
- Temporary reduction in air pollution decreases incidence of acute cardiovascular events ?
- Delay in seeking medical care leads to fewer MI !

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Published online: 17 March 2020

ORIGINAL

Pre-admission air pollution exposure prolongs the duration of ventilation in intensive care patients

Annick De Weerdt[1,2*], Bram G. Janssen[3], Bianca Cox[3], Esmée M. Bijnens[3], Charlotte Vanpoucke[4], Wouter Lefebvre[5], Omar El Salawi[2], Margot Jans[2], Walter Verbrugghe[1,2], Tim S. Nawrot[3,6] and Philippe G. Jorens[1,2]

Abstract

Purpose: Air pollutant exposure constitutes a serious risk factor for the emergence or aggravation of (existing) pulmonary disease. The impact of pre-intensive care ambient air pollutant exposure on the duration of artificial ventilation was, however, not yet established.

Methods: The medical records of 2003 patients, admitted to the intensive care unit (ICU) of the Antwerp University Hospital (Flanders, Belgium), who were artificially ventilated on ICU admission or within 48 h after admission, for the duration of at least 48 h, were analyzed. For each patient's home address, daily air pollutant exposure [particulate matter with an aerodynamic diameter ≤ 2.5 μm ($PM_{2.5}$) and ≤ 10 μm (PM_{10}), nitrogen dioxide (NO_2) and black carbon (BC)] up to 10 days prior to hospital admission was modeled using a high-resolution spatial–temporal model. The association between duration of artificial ventilation and air pollution exposure during the last 10 days before ICU admission was assessed using distributed lag models with a negative binomial regression fit.

Results: Controlling for pre-specified confounders, an IQR increment in BC (1.2 μg/m^3) up to 10 days before admission was associated with an estimated cumulative increase of 12.4% in ventilation duration (95% CI 4.7–20.7). Significant associations were also observed for $PM_{2.5}$, PM_{10} and NO_2, with cumulative estimates ranging from 7.8 to 8.0%.

Conclusion: Short-term ambient air pollution exposure prior to ICU admission represents an unrecognized environmental risk factor for the duration of artificial ventilation in the ICU.

Keywords: Air pollution, Intensive care, Artificial ventilation, Mechanical ventilation, Critical care

ESC
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Cardiovascular Research
doi:10.1093/cvr/cvaa288

Regional and global contributions of air pollution to risk of death from COVID-19

Andrea Pozzer [1,2], Francesca Dominici[3], Andy Haines[4], Christian Witt [5], Thomas Münzel [6,7]*, and Jos Lelieveld [2,8]*

[1]International Center for Theoretical Physics, Trieste, Italy; [2]Max Planck Institute for Chemistry, Atmospheric Chemistry Department, Mainz, Germany; [3]Harvard T.H. Chan School of Public Health, Department of Biostatistics, Boston, MA, USA; [4]Centre for Climate Change and Planetary Health, London School of Hygiene and Tropical Medicine, London, UK; [5]Charité

We characterized global exposure to fine particulates based on satellite data, and calculated the anthropogenic fraction with an atmospheric chemistry model. The degree to which air pollution influences COVID-19 mortality was derived from epidemiological data in the USA and China. We estimate that particulate air pollution contributed ~15% (95% confidence interval 7–33%) to COVID-19 mortality worldwide, 27% (13 – 46%) in East Asia, 19% (8–41%) in Europe, and 17% (6–39%) in North America. Globally, ~50–60% of the attributable, anthropogenic fraction is related to fossil fuel use, up to 70–80% in Europe, West Asia, and North America.

Comments (23)

Exposure to air pollution and COVID-19 mortality in the United States: A nationwide cross-sectional study

Xiao Wu, Rachel C. Nethery, Benjamin M. Sabath, Danielle Braun, Francesca Dominici

doi: https://doi.org/10.1101/2020.04.05.20054502

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state. We conducted more than 68 additional sensitivity analyses. Results: We found that an increase of only 1 μg/m³ in $PM_{2.5}$ is associated with an 8% increase in the COVID-19 death rate (95% confidence interval [CI]: 2%, 15%). The results were statistically significant and robust to secondary and sensitivity analyses. Conclusions: A small increase in long-term exposure to $PM_{2.5}$ leads to a large increase in the COVID-19 death rate. Despite the inherent limitations of the ecological study design,

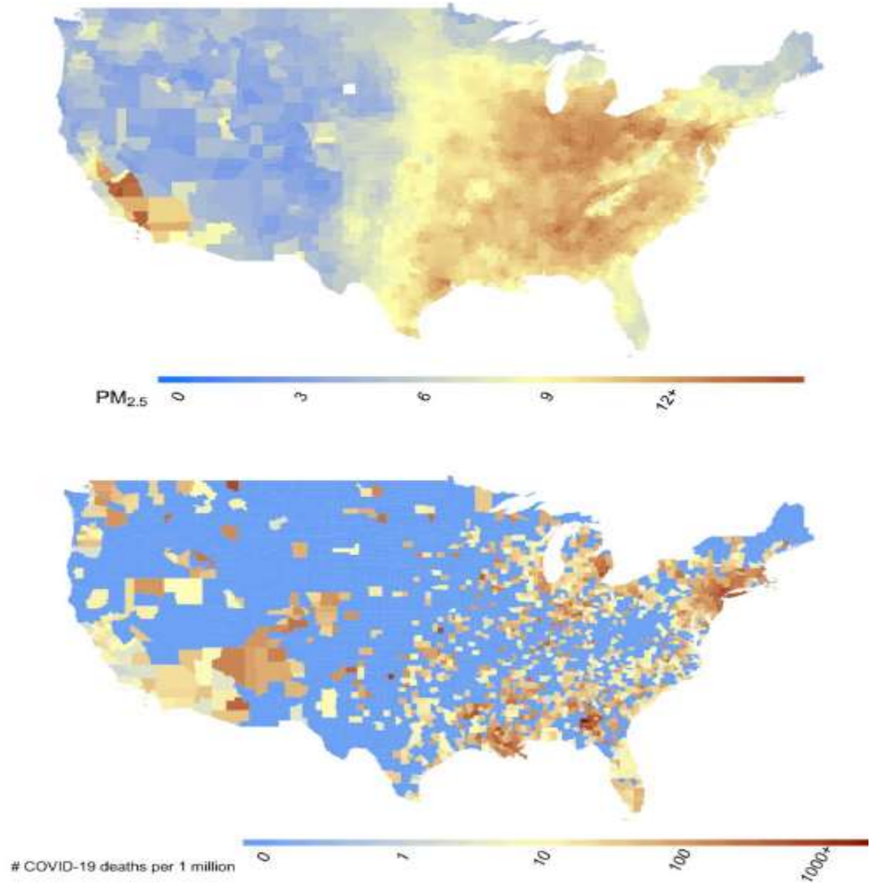

Fig 1: Maps show (a) county-level 17-year long-term average of $PM_{2.5}$ concentrations (2000–2016) in the United States in $\mu g/m3$, and (b) county-level number of COVID-19 deaths per 1 million population in the United States up to and including April 22, 2020.

Wu *et al.*, *Sci. Adv.* 2020; **6** : eabd4049 4 November 2020

CORONAVIRUS

Air pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis

X. Wu[1]*, R. C. Nethery[1]*, M. B. Sabath[1], D. Braun[1,2], F. Dominici[1†]

Assessing whether long-term exposure to air pollution increases the severity of COVID-19 health outcomes, including death, is an important public health objective. Limitations in COVID-19 data availability and quality remain obstacles to conducting conclusive studies on this topic. At present, publicly available COVID-19 outcome data for representative populations are available only as area-level counts. Therefore, studies of long-term exposure to air pollution and COVID-19 outcomes using these data must use an ecological regression analysis, which precludes controlling for individual-level COVID-19 risk factors. We describe these challenges in the context of one of the first preliminary investigations of this question in the United States, where we found that higher historical $PM_{2.5}$ exposures are positively associated with higher county-level COVID-19 mortality rates after accounting for many area-level confounders. Motivated by this study, we lay the groundwork for future research on this important topic, describe the challenges, and outline promising directions and opportunities.

findings to various modeling assumptions. We found that an increase of 1 μg/m^3 in the long-term average $PM_{2.5}$ is associated with a statistically significant 11% (95% CI, 6 to 17%) increase in the county's COVID-19 mortality rate (see Table 1); this association continues to be stable as more data accumulate (fig. S3). We also

Table 1. Mortality rate ratios (MRR), 95% confidence intervals (CI), and *P* values for all variables in the main analysis. Details of the statistical models are available in section S2. Q, quintile.

	MRR	95% CI	*P* value
$PM_{2.5}$	1.11	(1.06–1.17)	0.00
Population density (Q2)	0.91	(0.71–1.15)	0.42
Population density (Q3)	0.91	(0.71–1.16)	0.45
Population density (Q4)	0.74	(0.57–0.95)	0.02
Population density (Q5)	0.92	(0.69–1.23)	0.56
% In poverty	1.04	(0.96–1.12)	0.31
Log(median house value)	1.13	(0.99–1.29)	0.07
Log(median household income)	1.19	(1.04–1.35)	0.01
% Owner-occupied housing	1.12	(1.04–1.20)	0.00
% Less than high school education	1.20	(1.10–1.32)	0.00
% Black	1.49	(1.38–1.61)	0.00
% Hispanic	1.06	(0.97–1.16)	0.23
% ≥ 65 years of age	1.04	(0.93–1.17)	0.46
% 45–64 years of age	0.77	(0.67–0.90)	0.00
% 15–44 years of age	0.76	(0.68–0.85)	0.00
Days since stay-at-home order	1.18	(0.92–1.52)	0.20
Days since first case	2.40	(2.05–2.80)	0.00
Rate of hospital beds	1.00	(0.93–1.08)	0.95
% Obese	0.96	(0.90–1.03)	0.32
% Smokers	1.13	(1.00–1.28)	0.05
Average summer temperature (°F)	1.11	(0.95–1.30)	0.20
Average winter temperature (°F)	0.86	(0.69–1.07)	0.19
Average summer relative humidity (%)	0.93	(0.80–1.09)	0.38
Average winter relative humidity (%)	0.97	(0.87–1.07)	0.52

Wu *et al.*, *Sci. Adv.* 2020; **6** : eabd4049 4 November 2020

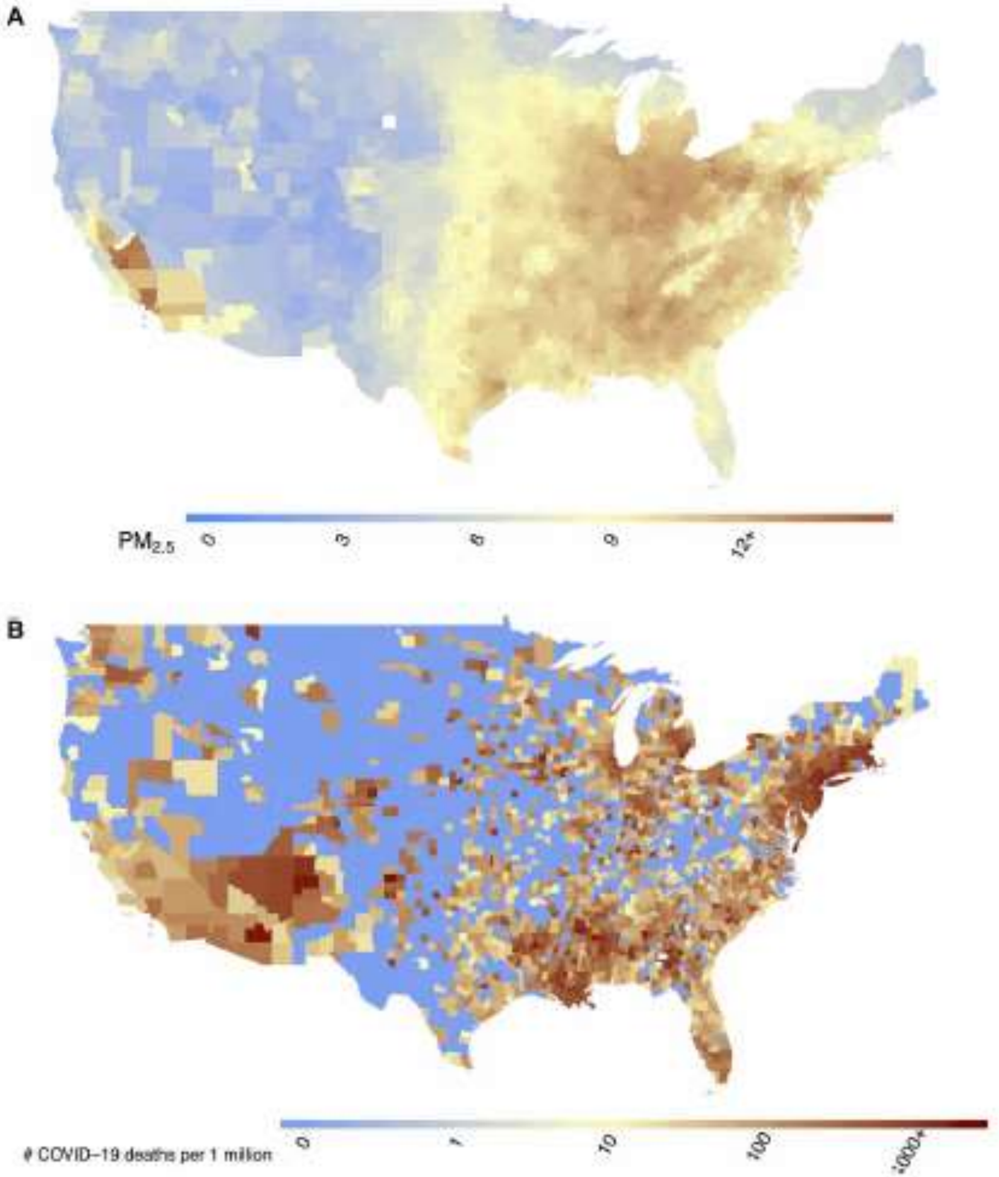

Fig. 1. National maps of historical $PM_{2.5}$ concentrations and COVID-19 deaths. Maps show (**A**) county-level 17-year long-term average of $PM_{2.5}$ concentrations (2000–2016) in the United States in μg/m³ and (**B**) county-level number of COVID-19 deaths per 1 million population in the United States up to and including 18 June 2020.

COVID-19 pandemic and admission rates for and management of acute coronary syndromes in England

Marion M Mafham*, Enti Spata*, Raphael Goldacre*, Dominic Gair, Paula Curnow, Mark Bray, Sam Hollings, Chris Roebuck, Chris P Gale, Mamas A Mamas, John E Deanfield, Mark A de Belder, Thomas F Luescher, Tom Denwood, Martin J Landray, Jonathan R Emberson, Rory Collins, Eva J A Morris†, Barbara Casadei†, Colin Baigent†

Summary

Background Several countries affected by the COVID-19 pandemic have reported a substantial drop in the number of patients attending the emergency department with acute coronary syndromes and a reduced number of cardiac procedures. We aimed to understand the scale, nature, and duration of changes to admissions for different types of acute coronary syndrome in England and to evaluate whether in-hospital management of patients has been affected as a result of the COVID-19 pandemic.

Methods We analysed data on hospital admissions in England for types of acute coronary syndrome from Jan 1, 2019, to May 24, 2020, that were recorded in the Secondary Uses Service Admitted Patient Care database. Admissions were classified as ST-elevation myocardial infarction (STEMI), non-STEMI (NSTEMI), myocardial infarction of unknown type, or ... on procedures underta... vention [PCI], PCI, an... nd procedures underta... vith 95% CIs.

Finding... falling from a 2019 ... uction of 40% (95% CI ... k of May, 2020, there w... the period of declinin... ary syndrome, includir... NSTEMI, with 1267 ad... f 42% (95% CI 38–46). ... TEMI (438 PCI procedu...) and NSTEMI (383 PC...). The median length o... days (1–5) by the end of March, 2020.

Interpretation Compared with the weekly average in 2019, there was a substantial reduction in the weekly numbers of patients with acute coronary syndrome who were admitted to hospital in England by the end of March, 2020, which had been partly reversed by the end of May, 2020. The reduced number of admissions during this period is likely to have resulted in increases in out-of-hospital deaths and long-term complications of myocardial infarction and missed opportunities to offer secondary prevention treatment for patients with coronary heart disease. The full extent of the effect of COVID-19 on the management of patients with acute coronary syndrome will continue to be assessed by updating these analyses.

> with heart attack symptoms were encouraged to attend hospital, could have helped to allay such fears.[20] The observation that the decline in admissions preceded the UK lockdown and, despite the continuing lockdown, had partly recovered by the end of May, 2020, suggests that environmental changes (eg, reduced air pollution), decreased physical activity, or diminished stress because of lockdown are unlikely to be major contributors to the noted trends in acute coronary syndrome admissions in the current pandemic.[21,22]

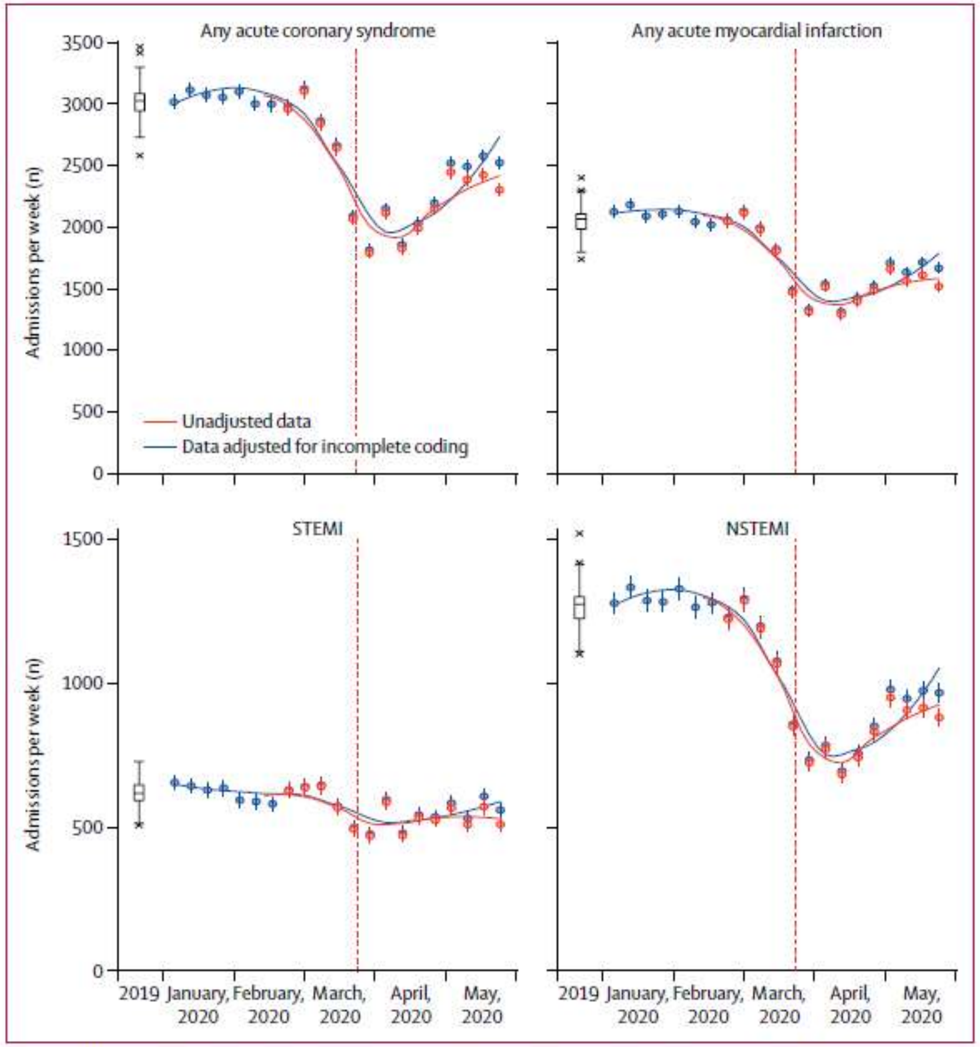

Figure 1: **Weekly admissions to acute National Health Service hospital trusts in England with an acute coronary syndrome, by type**

For weekly admissions in 2019, boxplots show the median and IQR, with whiskers extending (up to) 1·5 times the IQR above the upper quartile and below the lower quartile, with any weekly counts beyond those ranges indicated by x. For 2020, a locally estimated scatterplot smoothing spline is fitted through the weekly reported counts, with datapoints and SEs plotted. The date of the UK COVID-19 lockdown (March 23, 2020) is shown with a vertical dotted line. STEMI=ST-elevation myocardial infarction. NSTEMI=non-ST-elevation myocardial infarction.

ACTA CARDIOLOGICA
https://doi.org/10.1080/00015385.2020.1796035

ORIGINAL SCIENTIFIC PAPER

Impact of COVID-19-related public containment measures on the ST elevation myocardial infarction epidemic in Belgium: a nationwide, serial, cross-sectional study

Marc J. Claeys[a], Jean-François Argacha[b], Philippe Collart[c], Marc Carlier[d], Olivier Van Caenegem[e], Peter R. Sinnaeve[f], Walter Desmet[f], Philippe Dubois[g], Francis Stammen[h], Sofie Gevaert[i], Suzanne Pourbaix[j], Patrick Coussement[k], Christophe Beauloye[l], Patrick Evrard[m], Olivier Brasseur[n], Frans Fierens[o], Patrick Marechal[p], Dan Schelfaut[q], Vincent Floré[r] and Claude Hanet[s]

Conclusion: The present study revealed a 26% reduction in STEMI admissions and a delay in treatment of STEMI patients. Less exposure to external STEMI triggers (such as ambient air pollution) and/or reluctance to seek medical care are possible explanations of this observation.

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medRxiv preprint doi: https://doi.org/10.1101/2020.04.15.20065995.this version posted April 18, 2020.

Letter to the Editor

SARS-Cov-2 RNA Found on Particulate Matter of Bergamo in Northern Italy: First Preliminary Evidence

Leonardo Setti[1], Fabrizio Passarini[2], Gianluigi De Gennaro[3], Pierluigi Barbieri[4], Maria Grazia Perrone[5], Massimo Borelli[6], Jolanda Palmisani[3], Alessia Di Gilio[3], Valentina Torboli[6], Alberto Pallavicini[6], Maurizio Ruscio[7], Prisco Piscitelli[8], Alessandro Miani[8,9]

3. Dispersion of SARS-CoV-2 via pollutant particles?

Environmental Research 186 (2020) 109639

Contents lists available at ScienceDirect

Environmental Research

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

First data analysis about possible COVID-19 virus airborne diffusion due to air particulate matter (PM): The case of Lombardy (Italy)

E. Bontempi

INSTM and Chemistry for Technologies, University of Brescia, Via Branze 38, 25123, Brescia, Italy

Alessandria, Vercelli, Novara, Biella, Asti, and Torino (Piedmont). The results show that it is not possible to conclude that COVID-19 diffusion mechanism also occurs through the air, by using PM_{10} as a carrier. In particular, it is shown that Piedmont cities, presenting lower detected infections cases in comparison to Brescia and Bergamo in the investigated period, had most sever PM_{10} pollution events in comparison to Lombardy cities.

3. Dispersion of SARS-CoV-2 via pollutant particles?

Belosi *et al. Environmental Research* (in press)

"On the concentrationof SARS-CoV-2 in outdoor air and the interaction with pre-existing atmospheric particles."

- Oudoor: assuming 10% infected in the population, time necessary to inspire a quantum would be 31.5 [2.7-91] days (Milan) and 51.2 days [4.4-149] (Bergamo)
- Very low probability that pre-existing atmospheric particles scavenge virus aerosol (negligible)

ARTICLE IN PRESS
STOTEN-142881; No of Pages 6
Available online 13 October 2020, 142881

https://www.sciencedirect.com/science/article/pii/S0048969720364111?via%3Dihub

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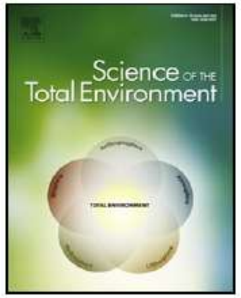

No SARS-CoV-2 detected in air samples (pollen and particulate matter) in Leipzig during the first spread

Susanne Dunker [a,b,*], Thomas Hornick [b,a], Grit Szczepankiewicz [c], Melanie Maier [c], Maximilian Bastl [d], Jan Bumberger [e], Regina Treudler [f], Uwe G. Liebert [c,1], Jan-Christoph Simon [f,1]

The SARS-CoV-2 pandemic co-occurred with pollen season in Europe 2020 and recent studies suggest a potential link between both. Air samples collected at our measuring station in Leipzig and purified pollen were analyzed for SARS-CoV-2 typical signals or for virus-induced cytopathic effects, to test if the virus could bind to bioaerosols and if so, whether these complexes are infectious. The results show that neither our air samples nor purified pollen were infectious or could act as carrier for virus particles.

COVID-19 and air pollution

1. Temporary improvements in air quality YES
2. Higher mortality in areas with higher air pollution? YES
3. Dispersion of SARS-CoV-2 via pollutant particles? NO

Eur Respir J 2012; 39: 525–528
DOI: 10.1183/09031936.00001112

Eur Respir J 2012, 39, 525-528

EDITORIAL

Ten principles for clean air

B. Brunekreef*,#, I. Annesi-Maesano¶,+, J.G. Ayres§, F. Forastiereƒ, B. Forsberg**, N. Künzli##,¶¶, J. Pekkanen++,§§ and T. Sigsgaardƒƒ

1) Citizens are entitled to clean air, just like clean water and safe food.

Thank you for your attention

ben.nemery@kuleuven.be