Webinar di aggiornamento sui principali problemi connessi all'inquinamento dell' aria per una strategia comune d'azione

26 settembre 2023

# Effetti sulla salute da esposizione cronica a basse dosi di inquinanti atmosferici


***Giovanni Viegi, MD, FERS, ATSF***

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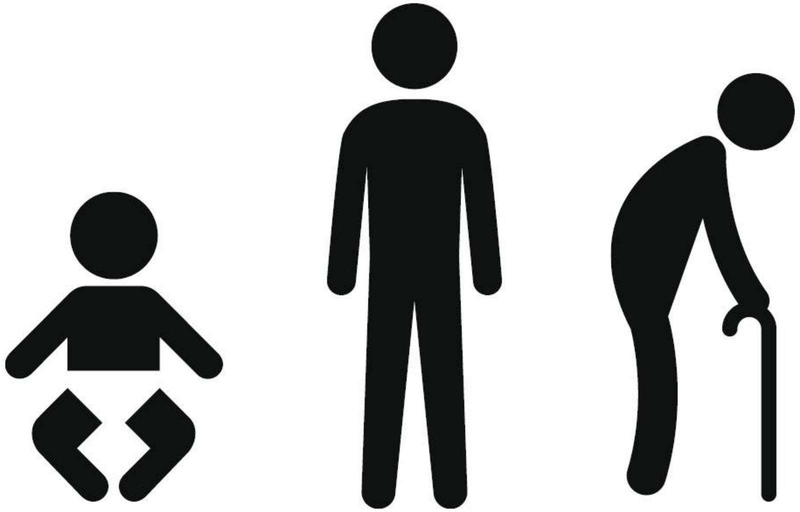
Senior Research Associate, CNR Institute of Clinical Physiology (IFC), Pisa
Professor of "Health Effects of Pollution", School of Environmental Sciences, University of Pisa
2005-06 President European Respiratory Society (ERS)
2017-22 WHO - GARD Planning Group Member


Durata: 20'

Air pollution affects 100% of the population from unborn babies to the very elderly

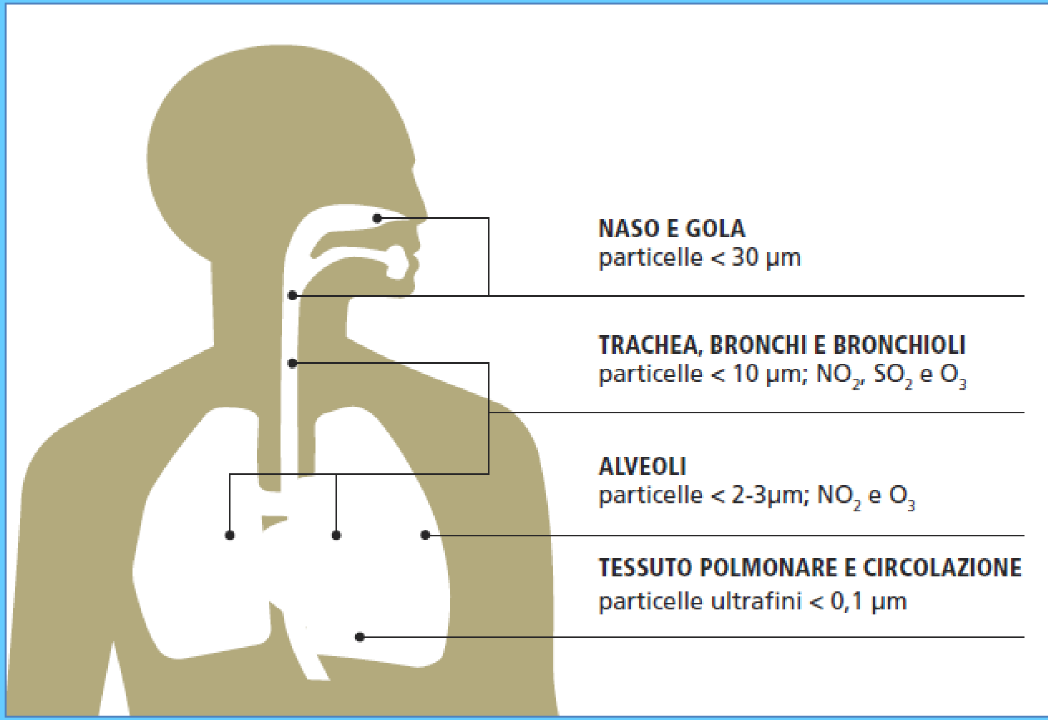
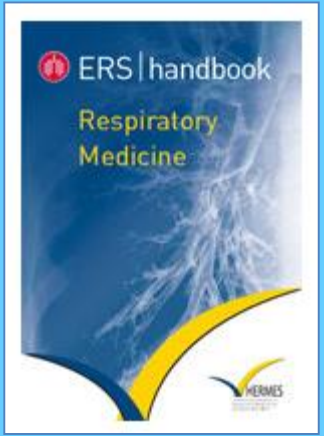




**Figura 4.** Penetrazione degli inquinanti nel tratto respiratorio. Modificata da Künzli et al.

Sarno G, Maio S, Simoni M, Baldacci S, Cerrai S, Viegi G a nome del Gruppo collaborativo EPIAIR2. Inquinamento atmosferico e salute umana. Ovvero come orientarsi nella lettura e interpretazione di studi ambientali, tossicologici ed epidemiologici. Edizione seconda. Epidemiol &Prev 2013;4/5(suppl 2):1-86




9/4/13

**ERS Handbook: Respiratory Medicine**

Indoor and outdoor pollution

Giovanni Viegi, Marzia Simoni, Sara Maio, Sonia Cerrai,
Giuseppe Sarno and Sandra Baldacci

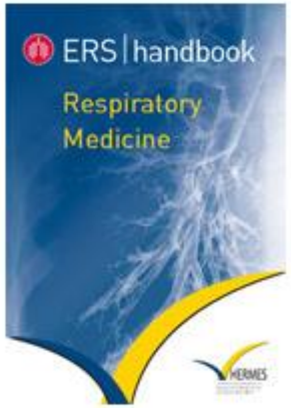


## Table 1

## *Major outdoor/indoor pollutants and related health effects*

| Pollutant | Major sources | Health effects |
|---|---|---|
| **Particulate matter** | Outdoor | Lung cancer |
| | Vehicular traffic | Premature death |
| | Organic matter and fossil fuel combustion | Mortality for cardiorespiratory diseases |
| | Power stations/industry | Reduced lung function |
| | Windblown dust from roadways, agriculture and construction | Lower airway inflammation |
| | Bushfires/dust storms | Upper airways irritation |
| | Indoor | Neurological, cardiovascular diseases, metabolic disorders |
| | Woodstoves | |
| | Organic matter and fossil fuel combustion for heating/cooking | |
| | ETS | |
| **Nitrogen dioxide** | Outdoor | Exacerbation of asthma |
| | Vehicular traffic | Airway inflammation |
| | Power stations/industry | Bronchial hyperresponsiveness |
| | Indoor | Increased susceptibility to respiratory infection |
| | Unvented gas/kerosene appliances | Reduced lung function |

Viegi G, et al. Indoor and outdoor pollution. In "ERS Handbook, Respiratory Medicine 3rd Edition", Palange P, Rohde G eds., European Respiratory Society, Sheffield (UK) 2019: pp 771-778.




9/4/13

## ERS Handbook: Respiratory Medicine

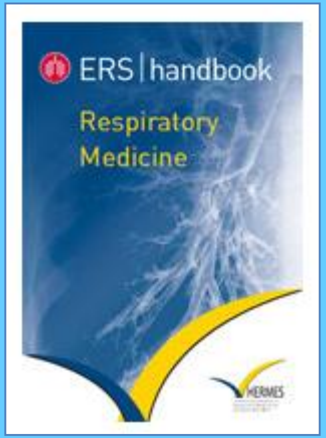
### Indoor and outdoor pollution

Giovanni Viegi, Marzia Simoni, Sara Maio, Sonia Cerrai,
Giuseppe Sarno and Sandra Baldacci

Part II of III

| Pollutant | Major sources | Health effects |
|---|---|---|
| **Ozone** | Outdoor | Lung tissue damage |
| | Sunlight chemical reaction with other pollutants | Reduced lung function |
| | Vehicular traffic | Reduced exercise capacity |
| | Power stations/industry | Exacerbation of asthma |
| | Consumer products | Upper airway and eye irritation |
| **Carbon monoxide** | Outdoor | Death/coma at very high levels |
| | Organic matter and fossil fuel combustion | Headache, nausea, breathlessness, confusion/reduced mental alertness |
| | Vehicular traffic | Low birth weight (fetal exposure) |
| | Domestic heating | |
| | Indoor | |
| | Organic matter and fossil fuel combustion for heating/cooking | |
| | Woodstoves | |
| | Unvented gas/kerosene appliances | |
| | ETS | |

Viegi G, et al. Indoor and outdoor pollution. In "ERS Handbook, Respiratory Medicine 3rd Edition", Palange P, Rohde G eds., European Respiratory Society, Sheffield (UK) 2019: pp 771-778.




9/4/13

# ERS Handbook: Respiratory Medicine

## Indoor and outdoor pollution

Giovanni Viegi, Marzia Simoni, Sara Maio, Sonia Cerrai, Giuseppe Sarno and Sandra Baldacci



| Pollutant | Major sources | Health effects |
|---|---|---|
| **Sulfur dioxide** | Outdoor<br>Coal/oil-burning power stations<br>Industry/refineries<br>Diesel engines<br>Metal smelting | Exacerbation of respiratory diseases including asthma<br>Respiratory tract irritation |
| **VOCs** | Indoor<br>Building materials and products such as new furniture, solvents, paint, adhesives, insulation<br>Cleaning activities and products<br>Materials for offices | Lung cancer<br>Asthma, dizziness, respiratory and lung diseases<br>Chronic eye, lung or skin irritation<br>Neurological and reproductive disorders |

Viegi G. et al. Indoor and outdoor pollution. In "ERS Handbook, Respiratory Medicine 3rd Edition", Palange P, Rohde G eds., European Respiratory Society, Sheffield (UK) 2019: pp 771-778.

# A joint ERS/ATS policy statement: what constitutes an adverse health effect of air pollution? An analytical framework

George D. Thurston[1], Howard Kipen[2], Isabella Annesi-Maesano[3], John Balmes[4,5], Robert D. Brook[6], Kevin Cromar[7], Sara De Matteis[8], Francesco Forastiere[9], Bertil Forsberg[10], Mark W. Frampton[11], Jonathan Grigg[12], Dick Heederik[13], Frank J. Kelly[14], Nino Kuenzli[15,16], Robert Laumbach[2], Annette Peters[17], Sanjay T. Rajagopalan[18], David Rich[19], Beate Ritz[20], Jonathan M. Samet[21], Thomas Sandstrom[11], Torben Sigsgaard[22], Jordi Sunyer[23] and Bert Brunekreef[13,24]

Eur Respir J 2017; 49: 1600419

FIGURE 1 Overview of diseases, conditions and biomarkers affected by outdoor air pollution. Updated based on [31]. Bold type indicates conditions currently included in the Global Burden of Disease categories.

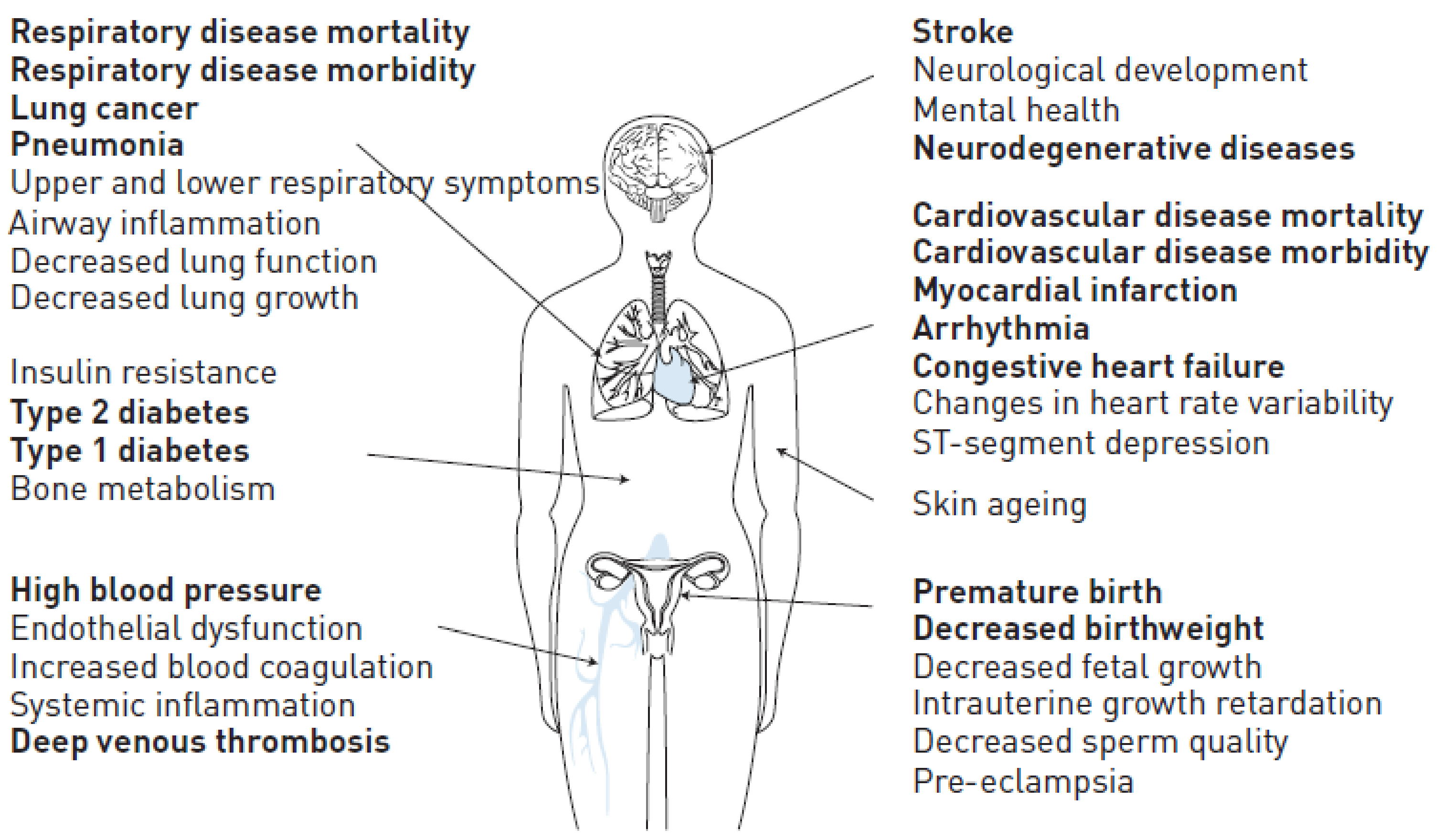


**TABLE 3 Examples of respiratory clinical effects associated with air pollution**

| |
|---|
| Increased respiratory mortality |
| Increased incidence of malignancies of the respiratory tract |
| Increased incidence, prevalence or frequency of exacerbations in chronic pulmonary disease: asthma, COPD and cystic fibrosis |
| Increased incidence or severity of upper and lower respiratory tract infections |
| Increased respiratory symptoms that affect quality of life: cough, phlegm, wheezing, dyspnoea and nasal drainage |
| Increased incidence of preterm birth, low birthweight or growth restriction leading to adverse respiratory outcomes |
| Reduced growth of lung function in children |
| Transient (hours) reductions in lung function associated with symptoms in healthy individuals |
| Transient (hours) reductions in lung function without symptoms in especially susceptible individuals (*e.g.* children with severe asthma) |
| Persistent or chronic (weeks, months or years) reductions in lung function |

COPD: chronic obstructive pulmonary disease.

**TABLE 4 Examples of biomarkers of potentially adverse respiratory health effects**

| |
|---|
| Increased levels of markers of airway inflammation (*e.g.* PMNs or inflammatory cytokines in BAL or sputum) |
| Increased levels of markers of airway injury or inflammation in exhaled breath (*e.g.* increased acidity of exhaled breath condensate or increased $F_{eNO}$ in asthmatics) |
| Increased levels of blood markers of lung injury (*e.g.* 8-isoprostanes, club cell secretory protein) |
| Imaging evidence for lung injury or reduced lung volume |
| Reduced pulmonary gas exchange (*e.g.* $D_{LCO}$, $D_{LNO}$, $P_{aO_2}$, pulse oximetry) |
| Increased airways responsiveness to nonspecific challenge |
| Increased airways hyperresponsiveness in asthmatic patients |

PMN: polymorphonuclear leukocyte; BAL: bronchoalveolar lavage; $F_{eNO}$: exhaled nitric oxide fraction; $D_{LCO}$: diffusing capacity of the lung for carbon monoxide; $D_{LNO}$: diffusing capacity of the lung for nitric oxide; $P_{aO_2}$: arterial oxygen tension.

Thurston, ERJ 2017

**TABLE 5 Cardiovascular clinical effects associated with air pollution**

| |
|---|
| Cardiovascular disease mortality |
| Myocardial infarction |
| Stroke |
| Increased blood pressure |
| Arrhythmias |
| Hospital admissions for congestive heart failure |

**TABLE 6 Illustrative examples of biomarkers of cardiovascular effects**

| |
|---|
| Decreased heart rate variability |
| Changes in ECG depolarisation and repolarisation |
| Increased carotid intima-media thickness |
| Increased coronary artery calcification |
| Carotid artery stenosis |
| Increased aortic calcification |
| Increased arterial stiffness |
| Impaired vascular endothelial function |
| Impaired vascular fibrinolysis |
| Increased platelet adhesiveness or activation |
| Increased thrombogenicity |
| Increased markers of systemic inflammation, endothelial function, nitric oxide metabolism, oxidation *etc.* |

Thurston, ERJ 2017

TABLE 7 Neurological and psychiatric conditions tentatively associated with air pollution and examples of markers of neurological effects

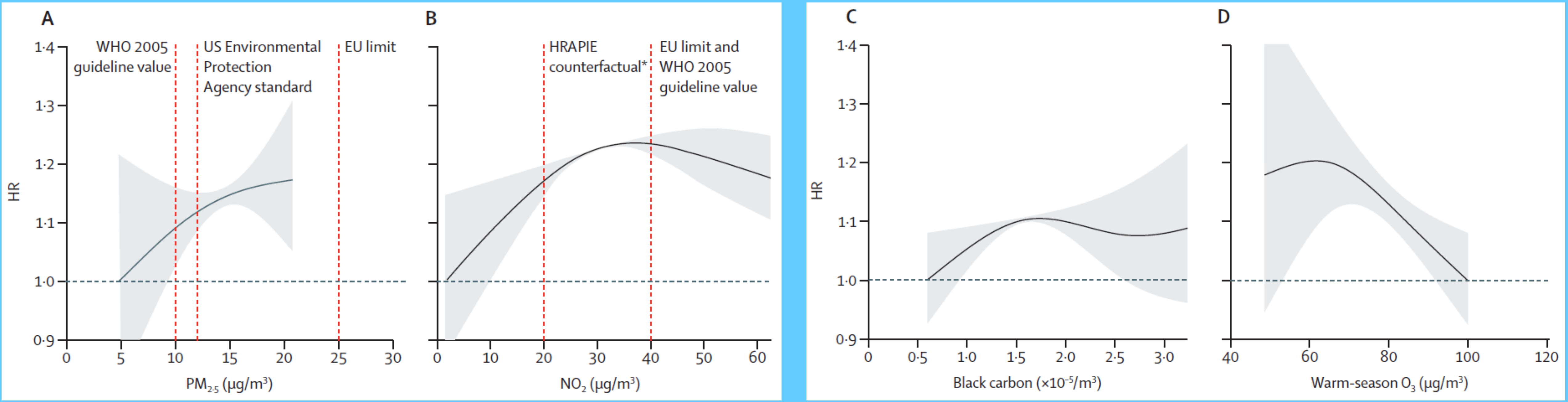
| | |
|---|---|
| **Conditions** | Alzheimer's disease and other dementias |
| | Parkinson's disease |
| | Reduced cognitive function in adults |
| | Delayed neurodevelopment in children |
| | Depression |
| | Anxiety disorders |
| **Markers** | Structural brain damage at functional magnetic resonance imaging |
| | Neurobehavioral testing |
| | Cognitive function testing |

Thurston, ERJ 2017

**Figure 3: Meta-analytical concentration-response functions of the association between air pollutants and non-accidental mortality**

Cohort-specific models were adjusted for individual-level and area-level covariates available in the administrative cohorts (appendix p 11). Meta-analytical curves were obtained by meta-smoothing with natural splines with three degrees of freedom. The shaded regions are 95% CIs. HR=hazard ratio. $NO_2$=nitrogen dioxide. $O_3$=ozone. $PM_{2·5}$=fine particulate matter. *HRAPIE-suggested counterfactual below which no health impact is quantified.[21]






Stafoggia, Lancet Planet Health 2022

**WEB REPORT**

# European Environment Agency (EEA)

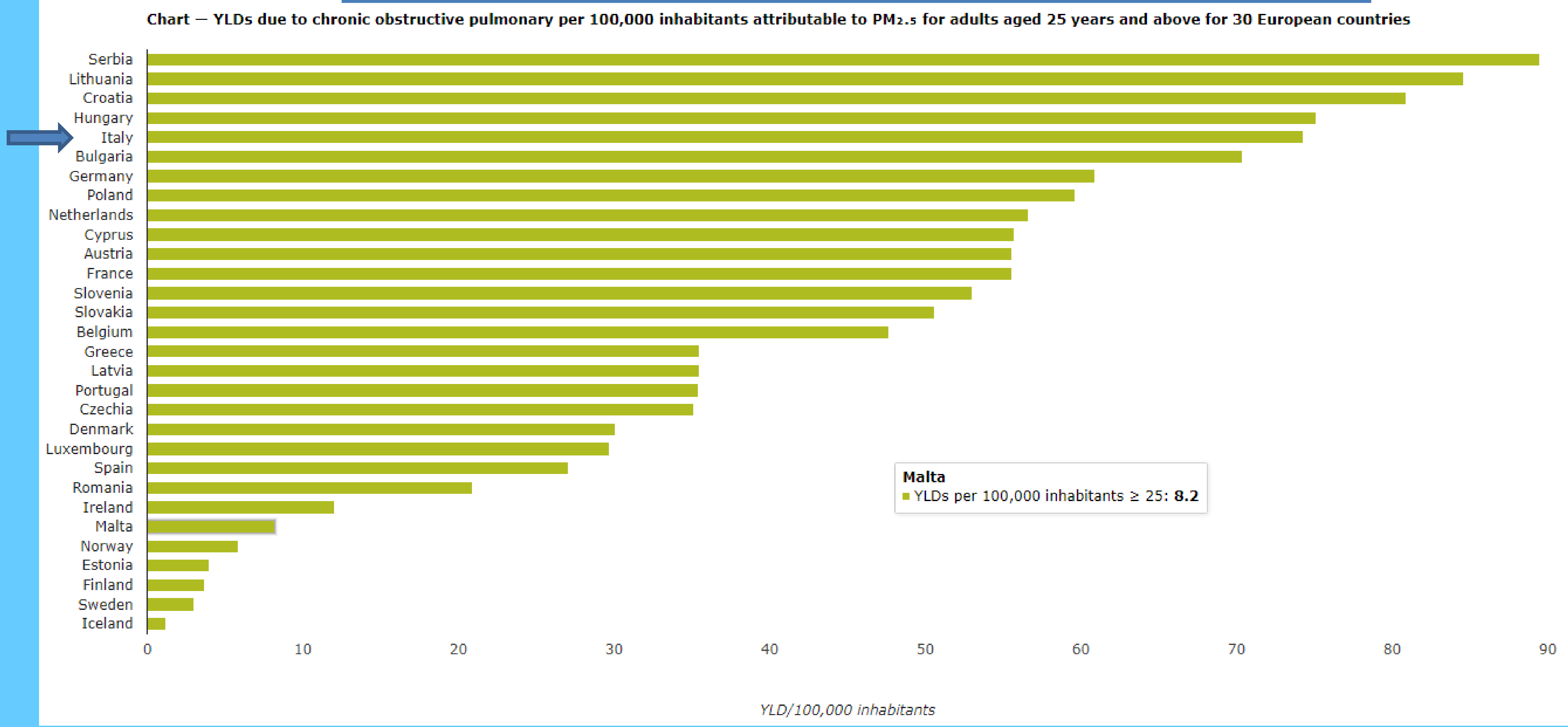
# Health impacts of air pollution in Europe, 2022

Published 24 Nov 2022 Last modified 01 Dec 2022

- For **$PM_{2.5}$**, the highest absolute numbers of premature deaths in 2020 were seen in **Italy**, Poland, Germany, Romania and Spain, in order of decreasing rank.
- For **$NO_2$**, the highest absolute numbers of premature deaths in 2020 were seen in Türkiye, **Italy**, Germany, Spain and France, in order of decreasing rank.
- The countries with the highest absolute numbers of premature deaths in 2020 due to exposure to **$O_3$** were **Italy**, Germany, France, Spain and Türkiye, in order of decreasing rank.

**https://www.eea.europa.eu//publications/air-quality-in-europe-2022**

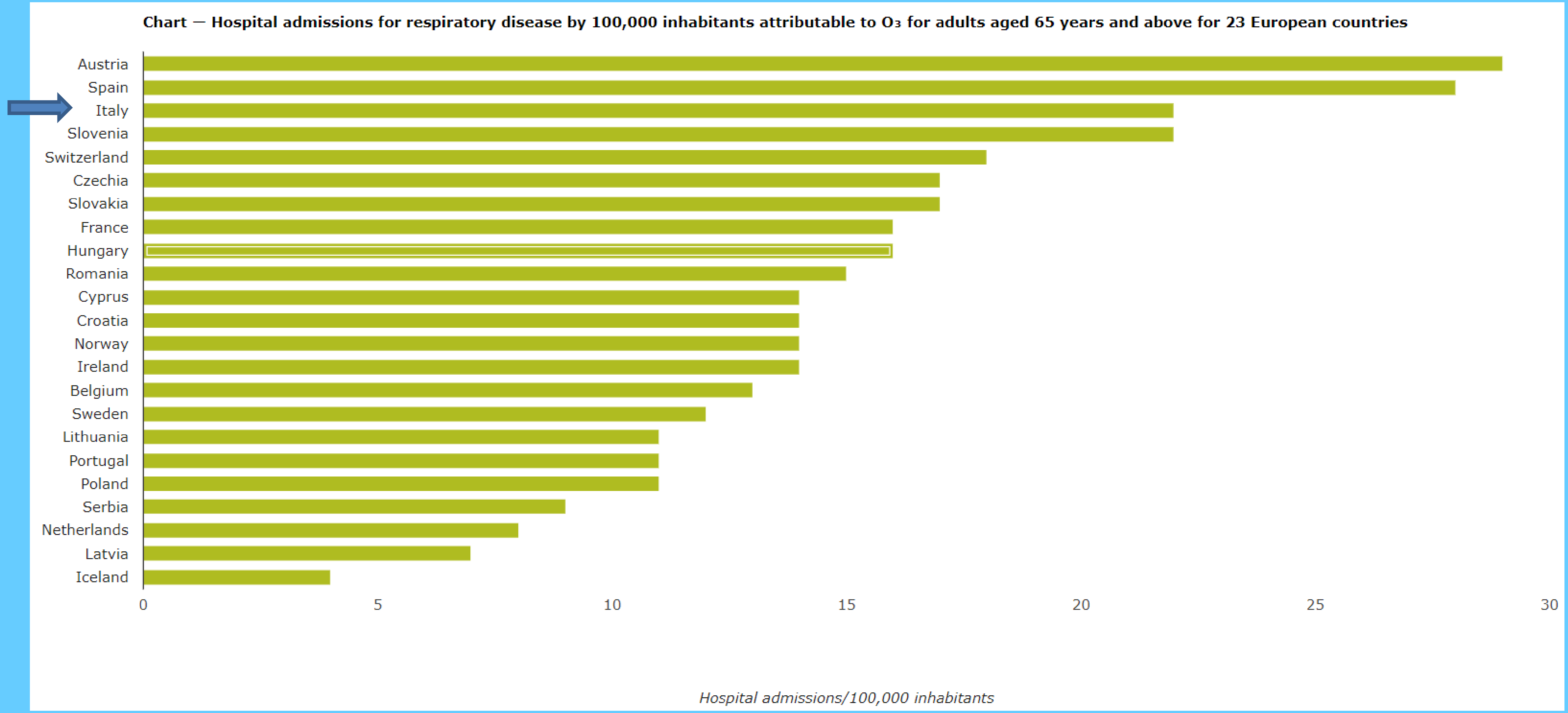
## Figure 2. YLDs due to chronic obstructive pulmonary disease per 100,000 inhabitants attributable to $PM_{2.5}$ for adults aged 25 and above for 30 European




**Note:**
- YLDs: years lived with disability.
- Although 41 European countries have been considered, based on the data availability, there was only possible to estimate the COPD disease burden for 30.

https://www.eea.europa.eu/publications/air-quality-in-europe-2022/health-impacts-of-air-pollution

## Figure 4. Hospital admissions for respiratory disease by 100,000 inhabitants attributable to $O_3$ for adults aged 65 and above for 23 European countries




**Note:**
Although 41 European countries have been considered, based on the data availability, there was only possible to estimate the hospital admissions for 23.

https://www.eea.europa.eu/publications/air-quality-in-europe-2022/health-impacts-of-air-pollution

European Environment Agency

WEB REPORT

# Beating cardiovascular disease — the role of Europe's environment

Cardiovascular disease affects the lives of many European residents. Environmental exposure to ambient and indoor air pollution, noise, extreme temperatures, second-hand smoke and chemicals, among other factors, significantly contribute to the high burden of cardiovascular illnesses in Europe. However, environmental risk factors for cardiovascular disease are largely preventable. This report provides a brief overview of the evidence about the environmental determinants of cardiovascular disease in Europe and corresponding EU policy responses.

Published 22 Jun 2023 — Last modified 22 Jun 2023 — 11 min read — Photo: © Rebekka D from Pixabay

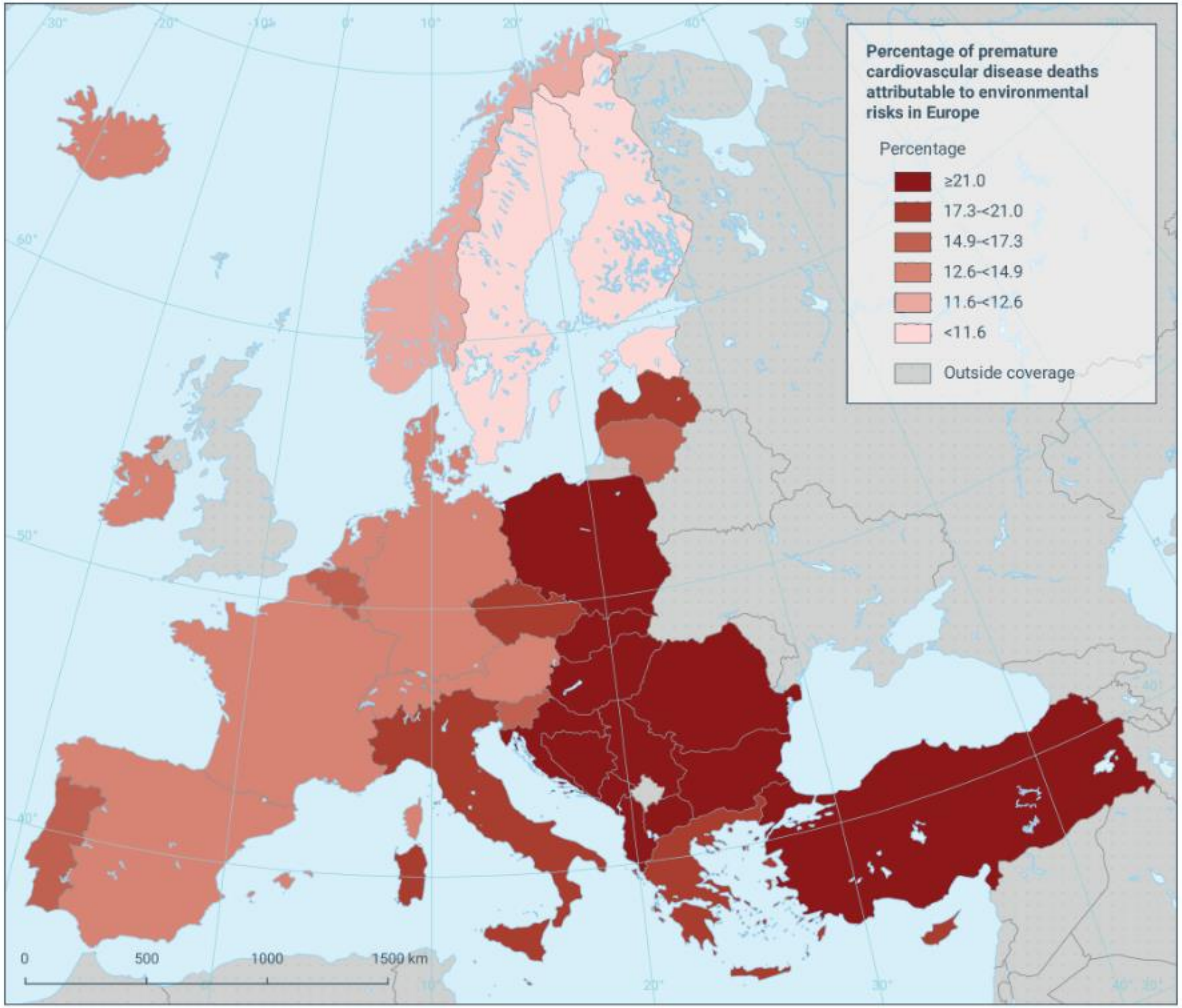
https://www.eea.europa.eu/publications/beating-cardiovascular-disease/

# Key messages

- Environmental risks are estimated to cause over 18% of cardiovascular disease-related deaths in Europe.
- Key environmental risk factors for cardiovascular disease in Europe include air pollution, heat and cold, noise, second-hand smoke and chemicals, notably lead.
- Cardiovascular disease prevention needs to target not only clinical and behavioural risk factors, but also environmental risks and their socioeconomic determinants.
- Reducing pollution and adapting to climate change can significantly reduce the number of cases of cardiovascular disease and resulting deaths.

https://www.eea.europa.eu/publications/beating-cardiovascular-disease/

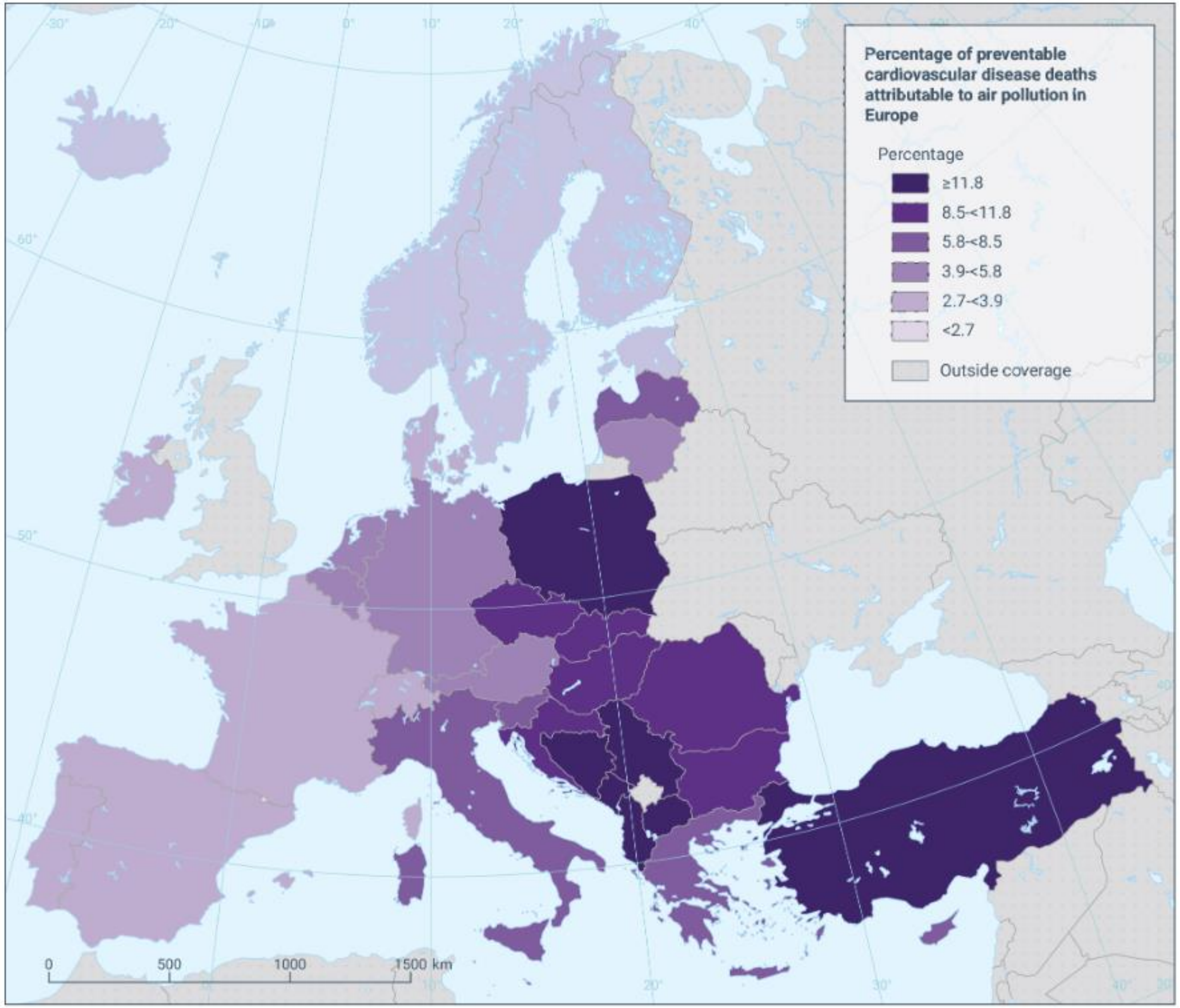
## Figure 2. Percentage of preventable cardiovascular disease deaths attributable to environmental risks in Europe




Reference data: © EuroGeographics, © FAO (UN), © TurkStat Source: European Commission - Eurostat/GISCO

https://www.eea.europa.eu/publications/beating-cardiovascular-disease/

**Figure 4. Percentage of preventable cardiovascular disease deaths attributable to air pollution in Europe**



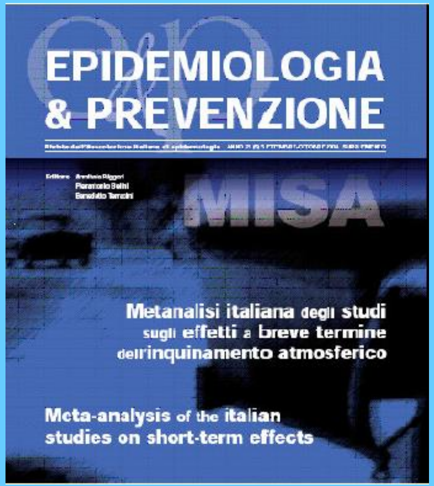

Reference data: © EuroGeographics, © FAO (UN), © TurkStat Source: European Commission – Eurostat/GISCO

https://www.eea.europa.eu/publications/beating-cardiovascular-disease/

In Italia sono stati realizzati numerosi studi epidemiologici con l'obiettivo di stimare l'associazione tra inquinanti atmosferici e salute respiratoria.

Lo studio MISA-1 (Metanalisi italiana degli studi sugli effetti a breve termine dell'inquinamento atmosferico) è iniziato nel 2000 e ha coinvolto 8 tra le principali città italiane (Torino, Milano, Verona, Ravenna, Bologna, Firenze, Roma e Palermo).

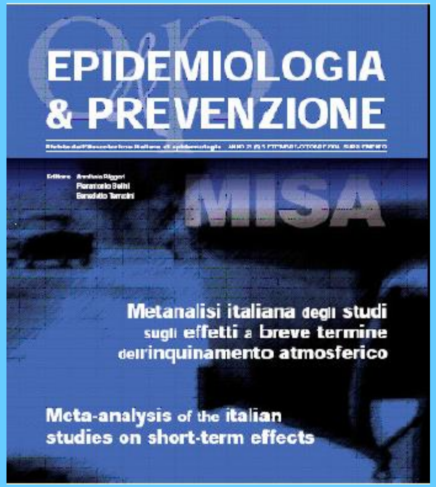
L'aggiornamento dei risultati (MISA-2), completato nel 2004, ha utilizzato tecniche di analisi e ha fornito stime d'effetto per 15 città italiane (Bologna, Catania, Firenze, Genova, Mestre-Venezia, Milano, Napoli, Palermo, Pisa, Ravenna, Roma, Taranto, Torino, Trieste, Verona). Il MISA-2 ha indagato 9.100.000 abitanti (censimento 2001). Sono stati analizzati 362.254 decessi e 794.528 ricoveri non programmati.




# MISA-2

## MISA 1996-2002: mortalità

| | Tutte le cause naturali | | | | Respiratorie | | | | Cardiovascolari | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *vp* | *95% ICr* | *τ* | *95% ICr* | *vp* | *95% ICr* | *τ* | *95% ICr* | *vp* | *95% ICr* | *τ* | *95% ICr* |
| SO2 | **0.60** | **-0.39,1.59** | *0.32* | *0.001,2.40* | **1.55** | **-2.22,5.38** | *5.80* | *0.001,51.84* | **1.11** | **-0.64,3.12** | *2.70* | *0.001,16.50* |
| NO2 | **0.59** | **0.26,0.94** | *0.13* | *0.001,0.65* | **0.38** | **-0.63,1.74** | *0.67* | *0.001, 4.01* | **0.40** | **-0.46,1.05** | *0.64* | *0.001, 3.52* |
| CO | **1.19** | **0.61,1.72** | *0.14* | *0.001,0.89* | **0.66** | **-1.46,2.88** | *3.44* | *0.001,22.51* | **0.93** | **-0.10,1.77** | *0.54* | *0.001, 3.38* |
| PM10 | **0.31** | **-0.19,0.74** | *0.32* | *0.011,1.16* | **0.54** | **-0.91,1.74** | *1.95* | *0.001,11.77* | **0.54** | **0.02,1.02** | *0.26* | *0.001,1.49* |
| O3 * | **0.27** | **-0.26,0.70** | *0.34* | *0.002,1.40* | **0.01** | **-1.67,1.30** | *1.72* | *0.001,11.65* | **0.22** | **-0.33,0.70** | *0.16* | *0.001,0.98* |




# MISA-2

## MISA 1996-2002: ricoveri

| | Respiratorie | | | | Cardiache | | | | Cerebrovascolari | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *vp* | *95% ICr* | *τ* | *95% ICr* | *vp* | *95% ICr* | *τ* | *95% ICr* | *vp* | *95% ICr* | *τ* | *95% ICr* |
| SO2 | -0.25 | -1.73,1.56 | *1.31* | *0.001,10.7* | -0.64 | -3.18,1.77 | *10.63* | *0.035,37.57* | 2.54 | -1.49,6.85 | *14.15* | *0.002,82.75* |
| NO2 | 0.77 | 0.08,1.50 | *0.84* | *0.094, 2.80* | 0.57 | 0.25,0.91 | *0.07* | *0.001, 0.45* | 0.77 | -0.18,2.10 | *1.19* | *0.001, 7.01* |
| CO | 1.25 | 0.19,2.25 | *1.03* | *0.002, 5.41* | 1.44 | 0.75,2.14 | *0.34* | *0.001, 2.62* | 0.93 | -2.00,4.45 | *16.99* | *0.020,55.56* |
| PM10 | 0.60 | 0.22,1.05 | *0.13* | *0.001, 0.65* | 0.29 | -0.04,0.59 | *0.07* | *0.001, 0.41* | -0.57 | -1.24,0.12 | *0.16* | *0.001, 1.22* |
| O3 * | 0.61 | -0.39,1.58 | *2.03* | *0.140, 6.48* | -0.41 | -0.73,-0.03 | *0.07* | *0.001, 0.43* | 0.20 | -0.64,1.08 | *0.41* | *0.001, 2.67* |

# I PROGETTI EPIAIR

I 2 progetti EpiAir costituiscono ampi studi sugli effetti a breve termine degli inquinanti atmosferici ($PM_{10}$, $NO_2$ , $O_3$ e, per la prima volta in Italia, $PM_{2.5}$) rilevati in 10 città italiane (Torino, Milano, Mestre-Venezia, Bologna, Firenze, Pisa, Roma, Taranto, Palermo, Cagliari), a cui si sono aggiunte altre 15 città nella seconda fase (Treviso, Padova, Rovigo, Trieste, Genova, Piacenza, Reggio Emilia, Parma, Modena, Rimini, Ferrara, Ancona, Napoli, Bari, Brindisi).


EpiAir2
Sorveglianza epidemiologica dell'inquinamento atmosferico
CCM
Centro Nazionale per la Prevenzione ed il Controllo delle Malattie
Ministero della Salute

# Short-Term Effects of Nitrogen Dioxide on Mortality and Susceptibility Factors in 10 Italian Cities: The EpiAir Study

*Monica Chiusolo,[1] Ennio Cadum,[1] Massimo Stafoggia,[2] Claudia Galassi,[3] Giovanna Berti,[1] Annunziata Faustini,[2] Luigi Bisanti,[4] Maria Angela Vigotti,[5] Maria Patrizia Dessì,[6] Achille Cernigliaro,[7] Sandra Mallone,[8] Barbara Pacelli,[9] Sante Minerba,[10] Lorenzo Simonato,[11] and Francesco Forastiere,[2] on behalf of the EpiAir Collaborative Group*

*Environ Health Perspect*

Online 17 May 2011

**EPIAIR 1**

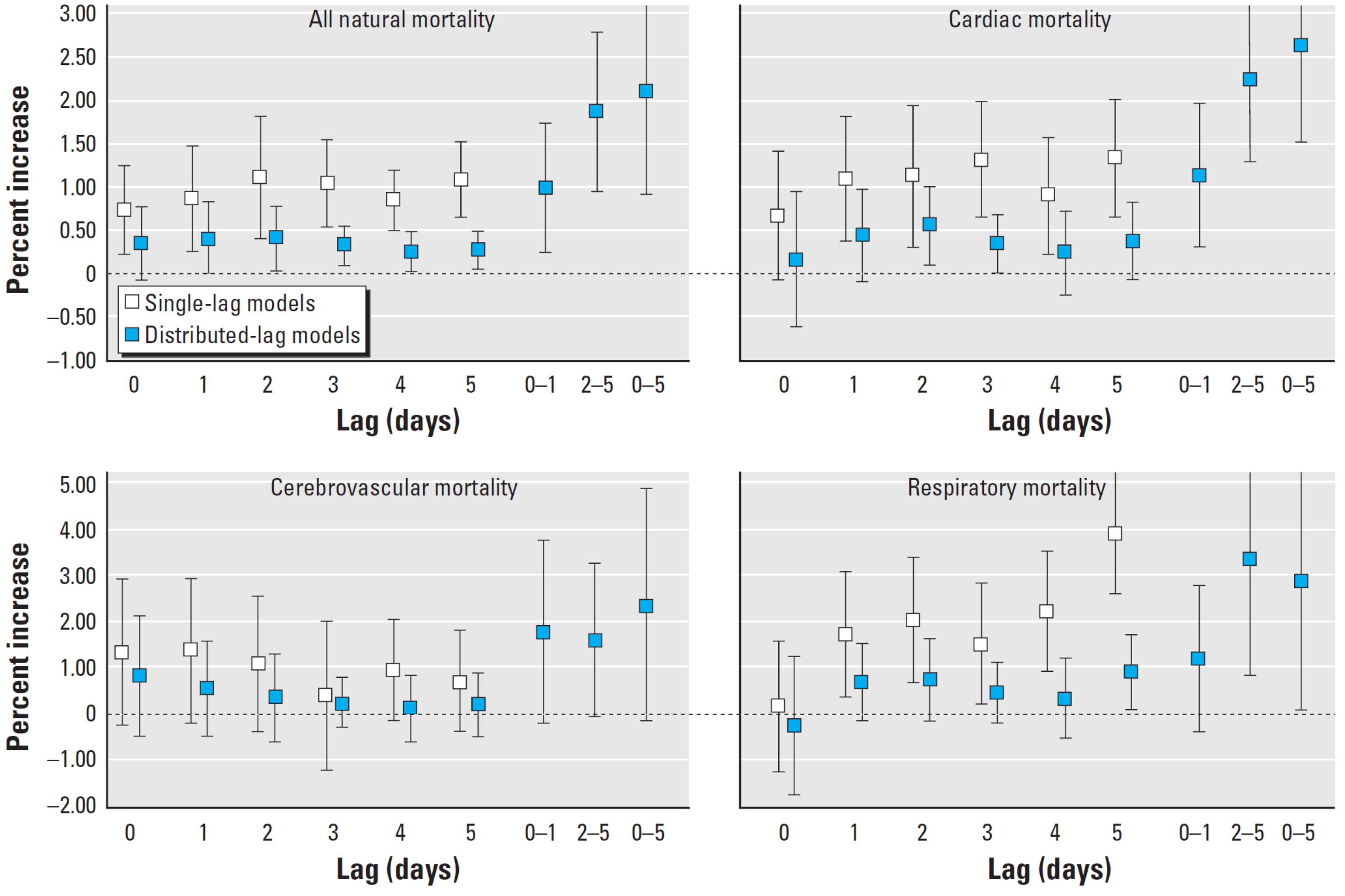



**Figure 1.** $NO_2$ and mortality, by cause of death and lag (single-lag and constrained and unconstrained distributed-lag models). Values shown are percent increases of risk (95% CI) for 10-µg/m$^3$ increases in $NO_2$ (pooled results from 10 cities), EpiAir Study, Italy, 2001–2005.

# The relationship between ambient particulate matter and respiratory mortality: a multi-city study in Italy

Eur Respir J 2011

**A. Faustini*, M. Stafoggia*, G. Berti#, L. Bisanti¶, M. Chiusolo#, A. Cernigliaro+, S. Mallone§, R. Primeranoƒ, C. Scarnato**, L. Simonato##, M.A. Vigotti¶¶ and F. Forastiere* on behalf of the EpiAir Collaborative Group++**

**EPIAIR 1**

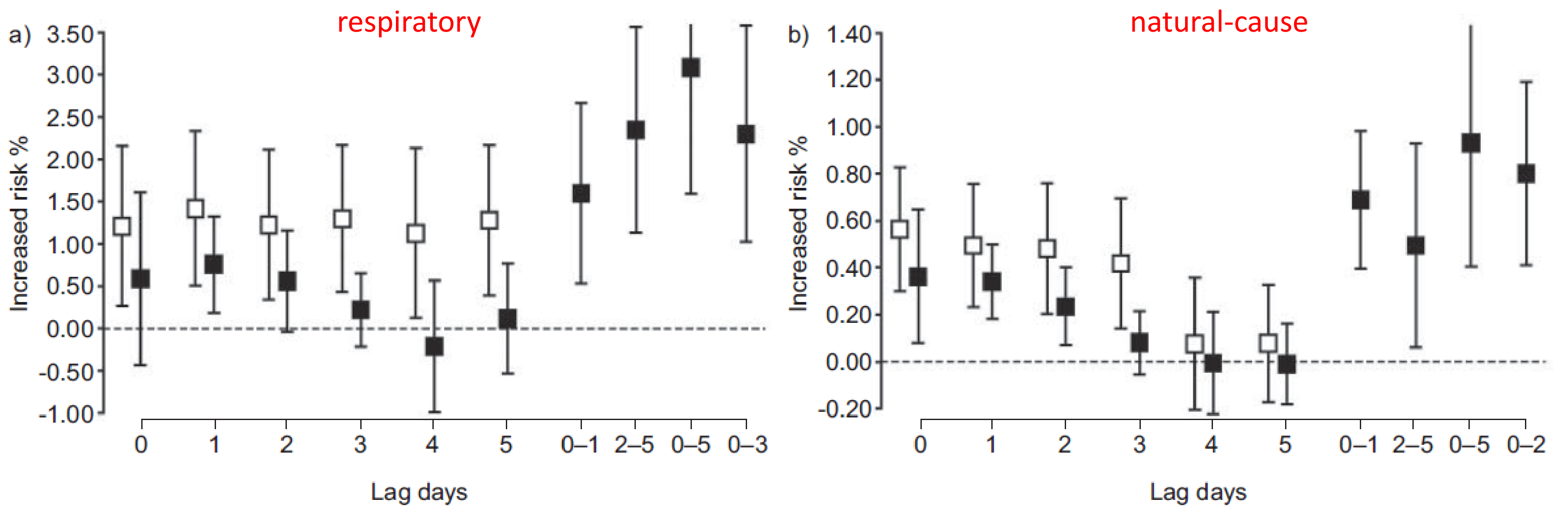



**FIGURE 1.** Pooled results. Association between particulate matter with a 50% cut-off aerodynamic diameter of 10 μm, and a) respiratory- and b) natural-cause mortality, by cause of death and lag (single-lag and distributed-lag models). Percentage increases of risk are shown with 95% confidence intervals, relative to a 10-μg·m$^{-3}$ increase in the pollutant. Data shown are for 10 Italian cities in 2001–2005. □: single-lag models; ■: distributed-lag models.

## Inquinamento atmosferico e ricoveri ospedalieri urgenti in nove città italiane. Risultati del Progetto EpiAir

Air pollution and urgent hospital admissions in nine Italian cities. Results of the EpiAir Project

Paola Colais,[1] Maria Serinelli,[2] Annunziata Faustini,[1] Massimo Stafoggia,[1] Giorgia Randi,[3] Roberta Tessari,[4] Monica Chiusolo,[5] Barbara Pacelli,[6] Sandra Mallone,[7] Maria Angela Vigotti,[8] Achille Cernigliaro,[9] Claudia Galassi,[10] Giovanna Berti[5] e Francesco Forastiere[1] per il Gruppo collaborativo EpiAir

**EPIAIR 1**

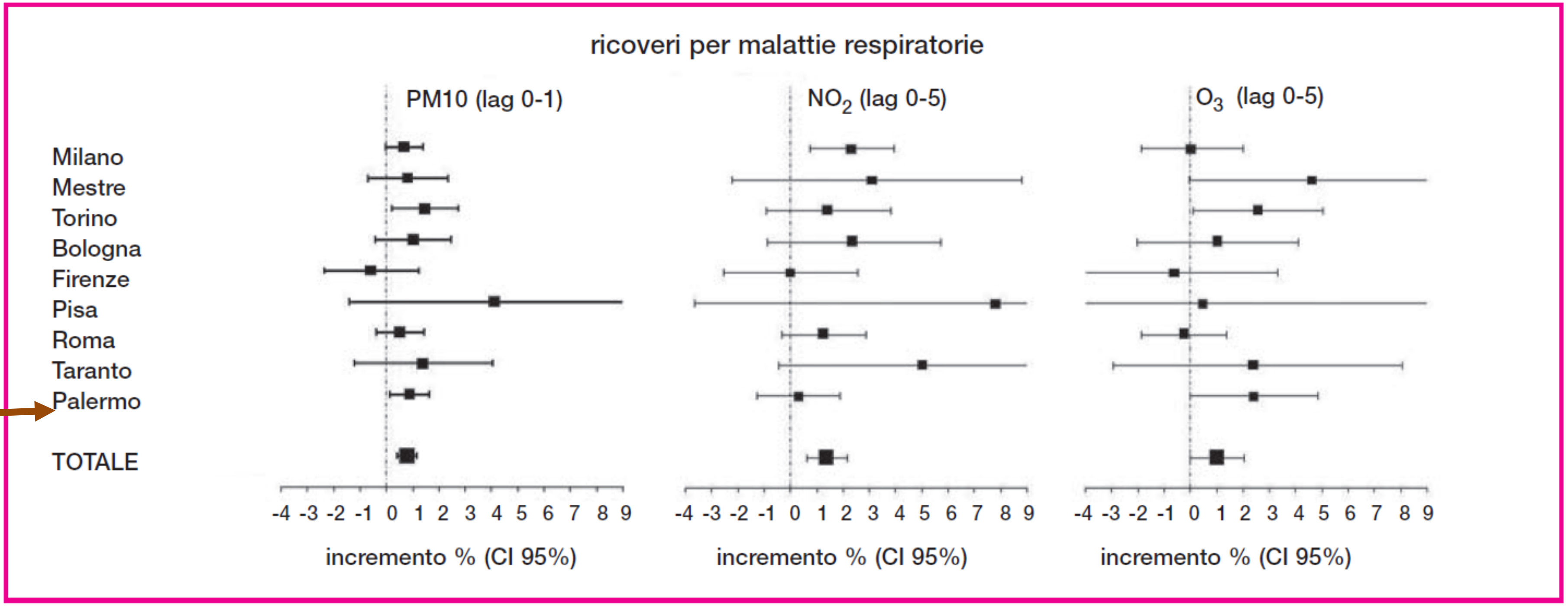



*Figura 6. Risultati città-specifici e metanalitici per le 9 città in studio, relativi all'associazione tra ricoveri per malattie respiratorie e inquinamento atmosferico, per inquinante: incrementi percentuali di rischio e intervalli di confidenza al 95%, corrispondenti a variazioni di 10 μg/m³ dell'inquinante, 2001-2005 (periodo aprile-settembre per l'ozono).*

*Figure 6. City-specific and pooled results for the 9 cities, on the association between hospitalizations for respiratory diseases and air pollution, by pollutant: percent increases of risk, and 95% confidence intervals, relative to 10 μg/m³ variations in the pollutant, 2001-2005 (April-September for ozone).*

WWW.EPIPREV.IT

Rassegne e Articoli

e&p anno 37 (4-5) luglio-ottobre 2013

# Inquinamento atmosferico e ricoveri ospedalieri urgenti in 25 città italiane: risultati del progetto EpiAir2

## Air pollution and urgent hospital admissions in 25 Italian cities: results from the EpiAir2 project

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**EPIAIR 2**

EPIAIR 2

Scarinzi et al, e&p 2013

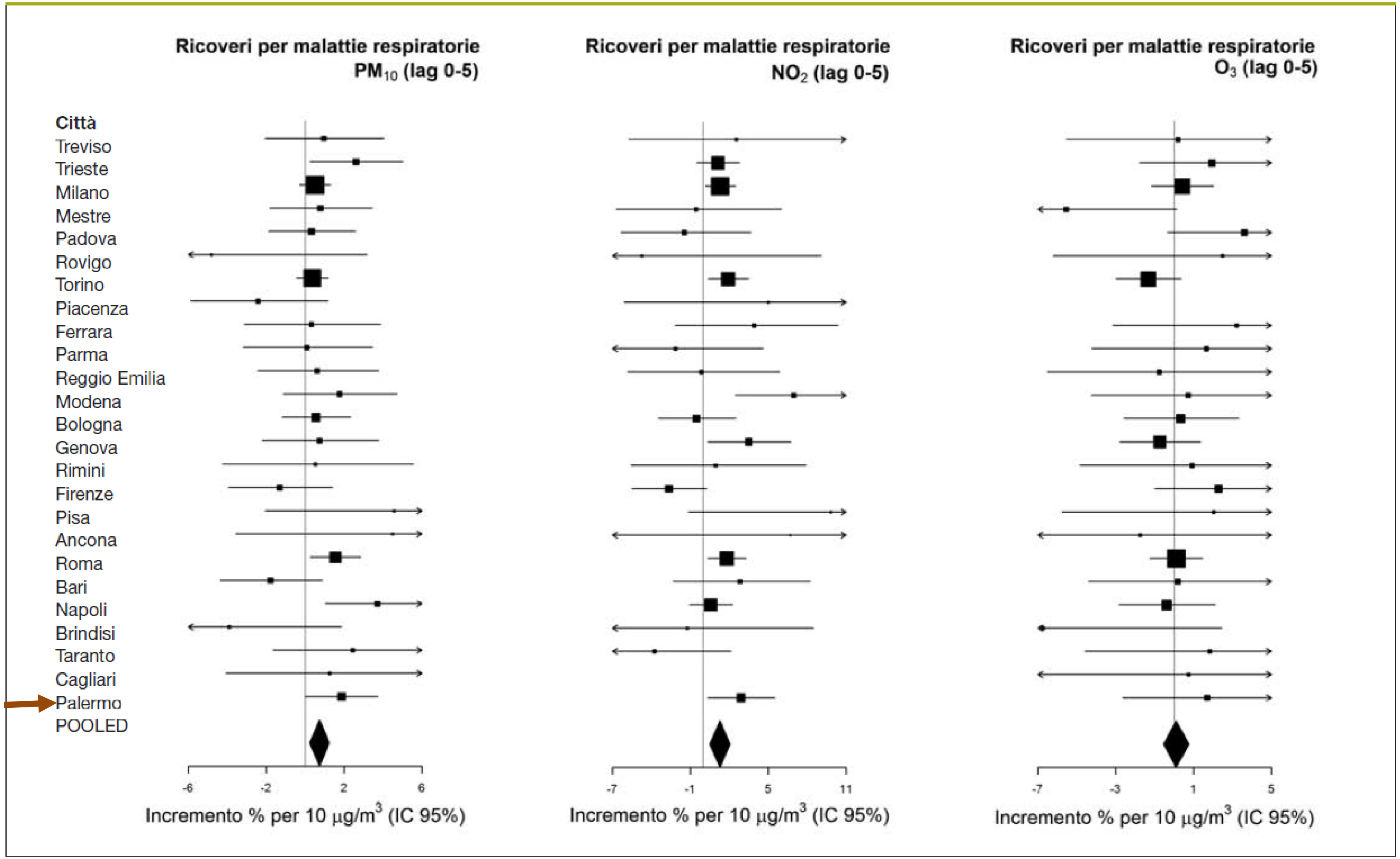
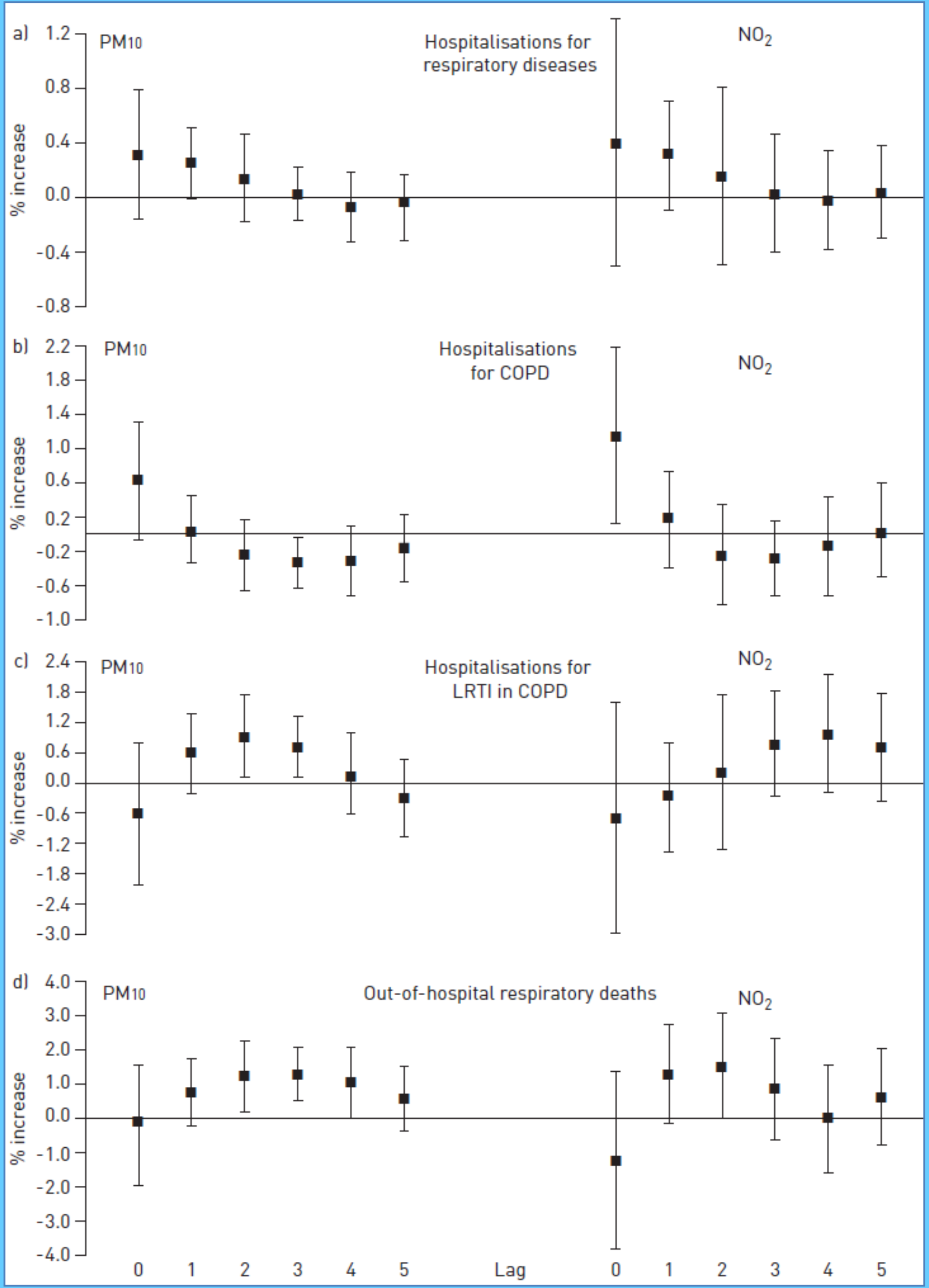



**Figura 3.** Risultati specifici per città e metanalitici per le 25 città in studio, relativi all'associazione tra ricoveri per malattie respiratorie e inquinamento atmosferico, per inquinante: incrementi percentuali di rischio e intervalli di confidenza al 95% corrispondenti a variazioni di 10 µg/m³ dell'inquinante, 2006-2010 (periodo aprile-settembre per l'ozono).

**Figure 3.** City-specific and meta-analytical results for the 25 cities under study, for respiratory causes and $PM_{10}$, $NO_2$ and $O_3$. Percent increase and 95%CI for 10 µg/m³ of each pollutant; 2006-2010 (period April-September for ozone).




Air pollution and multiple acute respiratory outcomes

Eur Respir J 2013;

Annunziata Faustini[1], Massimo Stafoggia[1], Paola Colais[1], Giovanna Berti[2], Luigi Bisanti[3], Ennio Cadum[2], Achille Cernigliaro[4], Sandra Mallone[5], Corrado Scarnato[6] and Francesco Forastiere[1] on behalf of the EpiAir Collaborative Group[7]

**Subjects aged ≥ 35 years from six Italian cities (Bologna, Florence, Milan, Palermo, Rome and Turin)**

FIGURE 1 Pooled results showing the association between multiple respiratory outcomes and particles with a 50% cut-off aerodynamic diameter of 10 mm (PM10) or nitrogen dioxide (NO2), by lag (from constrained distributed lag models), for six cities in 2001–2005. Data are presented as percentage increases of risk of respiratory outcome, and 95% confidence intervals, relative to a 10 mg?m-3 increase in PM10. In distributed lag models, a third-degree polynomial constrain for lags from 0 to 5 days has been applied.

www.viias.it

# Il progetto VIIAS

Nel 2005, in Italia, 34.552 decessi sono risultati attribuibili a livelli di concentrazione di $PM_{2.5}$ >10 $ug/m^3$

L'inquinamento accorcia mediamente la vita di ciascun italiano di 10 mesi (14 per chi vive al Nord)

Sono stati studiati scenari di riduzione delle emissioni attraverso politiche di contenimento e il solo rispetto dei limiti di legge salverebbe 11.000 vite all'anno.


Metodi per la Valutazione Integrata dell'Impatto Ambientale e Sanitario dell'inquinamento atmosferico

**Respiratory symptoms in children living near busy roads and their relationship to vehicular traffic: results of an Italian multicenter study (SIDRIA 2)**

Enrica Migliore*[1], Giovanna Berti[2], Claudia Galassi[1], Neil Pearce[3,4], Francesco Forastiere[5], Roberto Calabrese[1,6], Lucio Armenio[7], Annibale Biggeri[8,9], Luigi Bisanti[10], Massimiliano Bugiani[11], Ennio Cadum[2], Elisabetta Chellini[12], Valerio Dell'Orco[13], Gabriele Giannella[14], Piersante Sestini[15], Giuseppe Corbo[16], Riccardo Pistelli[16], Giovanni Viegi[17], Giovannino Ciccone[1] and SIDRIA-2 Collaborative Group

*Environmental Health* 2009,

*n=33632, age 6-7, 13-14 yrs*

Italy

**Table 3: Associations between traffic indicators and asthma symptoms and cough or phlegm**

| | Asthma symptoms | | | | Cough or phlegm | | | |
|---|---|---|---|---|---|---|---|---|
| | n cases | (%) | OR* | 95% CI | n cases | (%) | OR* | 95% CI |
| **Traffic density** | | | | | | | | |
| Absent | 564 | 12.5 | 1.00 | | 270 | 6.0 | 1.00 | |
| Low | 1,228 | 12.6 | 1.04 | 0.93–1.16 | 558 | 5.7 | 0.94 | 0.80–1.10 |
| Moderate | 1,375 | 13.8 | 1.13 | 1.01–1.26 | 689 | 6.9 | 1.04 | 0.89–1.22 |
| High | 795 | 14.6 | 1.17 | 1.03–1.33 | 475 | 8.7 | 1.24 | 1.04–1.49 |
| **Frequency cars transit** | | | | | | | | |
| Never | 309 | 12.7 | 1.00 | | 142 | 5.9 | 1.00 | |
| Sometimes | 1,147 | 12.1 | 0.95 | 0.83–1.10 | 517 | 5.5 | 0.90 | 0.74–1.10 |
| Frequently | 1,399 | 13.6 | 1.06 | 0.93–1.22 | 679 | 6.6 | 1.02 | 0.84–1.26 |
| Continuously | 1,108 | 14.9 | 1.16 | 1.00–1.33 | 656 | 8.8 | 1.32 | 1.08–1.63 |
| **Frequency trucks transit** | | | | | | | | |
| Never | 1,412 | 12.3 | 1.00 | | 652 | 5.7 | 1.00 | |
| Sometimes | 1,644 | 13.6 | 1.10 | 1.02–1.19 | 812 | 6.7 | 1.14 | 1.02–1.26 |
| Frequently | 682 | 14.5 | 1.16 | 1.05–1.29 | 399 | 8.5 | 1.41 | 1.23–1.61 |
| Continuously | 211 | 15.7 | 1.27 | 1.08–1.50 | 132 | 9.8 | 1.67 | 1.36–2.06 |

* All ORs were adjusted for study centre, age, sex, parental asthma or allergies, parental education, passive smoke at home, indoor moulds, season, person filling the questionnaire, floor level of the apartment and change of residence.

**Asthma symptoms and traffic**

SIDRIA

Studi italiani sui disturbi respiratori e l'ambiente

# CNR-IFC Study design: longitudinal, general population studies

***PO Delta 1***

**(1980-82,** n=3284, 8-64 yrs**)**
. Sampling
. CNR questionnaire
. Lung function test

***Pisa 1***

**(1985-88**,n=3865, 5-97yrs**)**
. Sampling
. CNR questionnaire

***PO Delta 2***

**(1988-91,** n=2841, 8-73yrs)
. CNR questionnaire
. Lung function test.
. Bronchial responsiveness
. Skin prick tests - Total serum IgE
.Nested: indoor

***Pisa 2***

**(1991-93**, n=2841, 8-97 yrs**)**
. CNR questionnaire
. Lung function tests
. Bronchial responsiveness
. Skin prick tests - Total serum IgE
. Mutagenetic determinations
. Nested indoor

***SEASD ****

(1997-98**,** n=2335, 13-99)
. Sub - sampling
. CNR questionnaire
. Blood sample collection
Urine sample collection
. Blood pressure, height, weight

***IMCAII °***

(2006-11, n=1620, 18-103yrs)
. Sub - sampling
. CNR questionnaire
. Lung function test
. Blood sample. Pulseoximeter
. Blood pressure, height, weight

° **I**ndicators for **M**onitoring **C**OPD and **A**sthma in the EU

# General Population: Urban factor

**Epidemiological Studies of Po Delta and Pisa**

**The Proportional Venn Diagram of Obstructive Lung Disease in the Italian General Population*** *Chest* 2004;126;1093-1101

*Giovanni Viegi, MD; Gabriella Matteelli, MD; Anna Angino, BS; Antonio Scognamiglio, MD; Sandra Baldacci, BSc; Joan B. Soriano, MD, PhD; and Laura Carrozzi, MD*

**Table 2—*Prevalence Rates of CB, Emphysema, and Asthma in the Two Italian General Population Samples***

| Disease | Po River Delta, % (n = 2,463) | Pisa, % (n = 1,890) | p Value* |
|---|---|---|---|
| OLD | 6.9 | 10.9 | 0.000 |
| Asthma only | 4.54 | 5.82 | |
| Asthma + CB | 0.28 | 0.21 | |
| Asthma + emphysema | 0.20 | 0.26 | |
| CB only | 0.89 | 1.22 | |
| CB + emphysema | 0.12 | 0.85 | |
| Emphysema only | 0.61 | 2.28 | |
| CB + emphysema + asthma | 0.24 | 0.21 | |

*By $\chi^2$ test.

Zona rurale | Zona urbana

[CANCER RESEARCH 58, 4122–4126, September 15, 1998]

# Serum Antibodies to Benzo(*a*)pyrene Diol Epoxide-DNA Adducts in the General Population: Effects of Air Pollution, Tobacco Smoking, and Family History of Lung Diseases[1]

Stefano Petruzzelli,[2] Alessandro Celi, Nolita Pulerà, Filomena Baliva, Giovanni Viegi, Laura Carrozzi, Gigliola Ciacchini, Matteo Bottai, Francesco Di Pede, Paolo Paoletti, and Carlo Giuntini

Table 3 *Multiple regression logistic analysis of the presence of serum anti-BPDE-DNA antibodies with questionnaire variables*

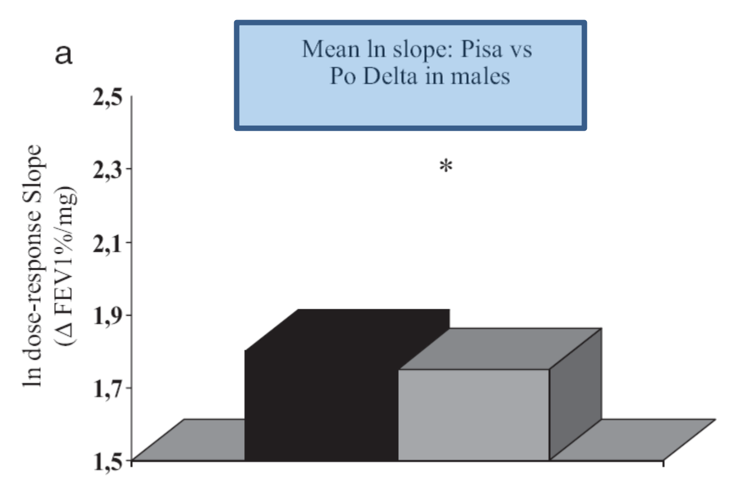
| | OR | 95% CI |
|---|---|---|
| Urban residence | 1.49 | 1.16–1.92 |
| Tobacco smoking | 1.25 | 1.06–1.48 |
| Passive smoking | 0.97 | 0.74–1.27 |
| Family history of chronic bronchitis | 1.02 | 0.65–1.60 |
| Family history of emphysema | 0.99 | 0.61–1.60 |
| Family history of lung cancer | 1.30 | 0.90–1.88 |
| Other members of the family cluster with serum anti-BPDE-DNA antibodies | 1.30 | 1.03–1.65 |

*General Population: Urban vs sub-urban factor*

# Urban residence is associated with bronchial hyper-responsiveness in Italian general population samples

Sara Maio, Sandra Baldacci, Laura Carrozzi, Eva Polverino, Anna Angino, Francesco Pistelli, Francesco Di Pede, Marzia Simoni, Duane Sherrill and Giovanni Viegi

*Chest* 2009;135;434-441



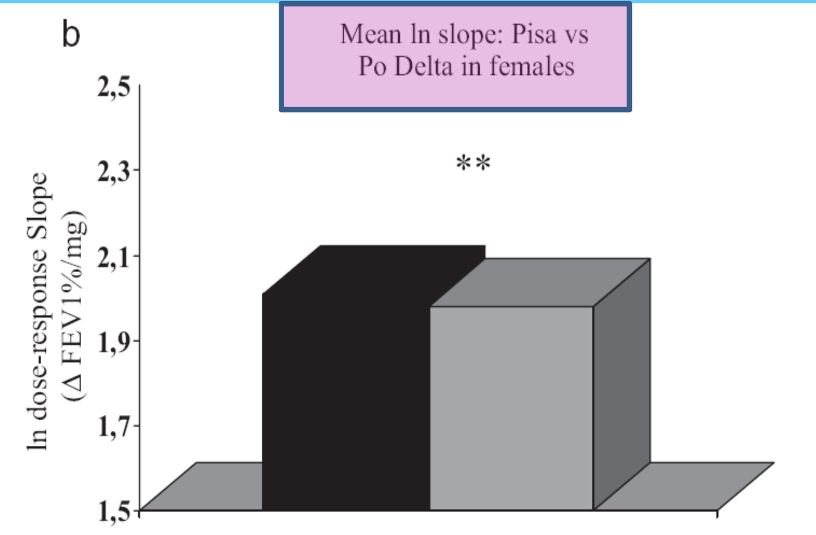




FIGURE 1. *Top*, *a*: *$p < 0.05$ with ANOVA. *Bottom*, *b*: **$p < 0.01$ with ANOVA. Gray columns indicate Po Delta; black columns indicate Pisa.

**Table 5. Effect of the independent variables on ln dose-response slope**

| | Odds Ratio | 95% Confidence Interva |
|---|---|---|
| **Gender:** | | |
| male | 1 | - |
| female | 1.97 | 1.57-2.46 |
| **Groups of age:** | | |
| 8-14 | 2.52 | 1.52-4.20 |
| 15-24 | 1.43 | 1.03-1.99 |
| 25-34 | 1 | - |
| 35-44 | 0.86 | 0.61-1.21 |
| 45-54 | 0.91 | 0.65-1.29 |
| 55-64 | 1.22 | 0.84-1.77 |
| 65-74 | 1.08 | 0.58-2.00 |
| **Smoking habits:** | | |
| never smoking | 1 | - |
| current smoking | 1.39 | 1.05-1.83 |
| ex smoking | 1.11 | 0.84-1.46 |
| **Respiratory symptoms/diseases:** | | |
| others | 1 | - |
| chronic bronchitis | 1.30 | 0.94-1.78 |
| asthma | 2.65 | 1.93-3.64 |
| **Prick test:** | | |
| negative | 1 | - |
| positive | 1.32 | 1.05-1.67 |
| **log IgE values:** | | |
| < 1.93* | 1 | - |
| ≥ 1.93 | 1.61 | 1.25-2.06 |
| **Residence:** | | |
| rural | 1 | - |
| urban | 1.41 | 1.13-1.76 |
| **Airway caliber** | 0.66 | 0.61-0.73 |

*corresponding real number = 85.11 kU/l

# Geographical information system and environmental epidemiology: a cross-sectional spatial analysis of the effects of traffic-related air pollution on population respiratory health

Daniela Nuvolone[1,2*], Roberto della Maggiore[2], Sara Maio[3], Roberto Fresco[2], Sandra Baldacci[3], Laura Carrozzi[3], Francesco Pistelli[3], Giovanni Viegi[3,4] *Environmental Health* 2011, **10**:12

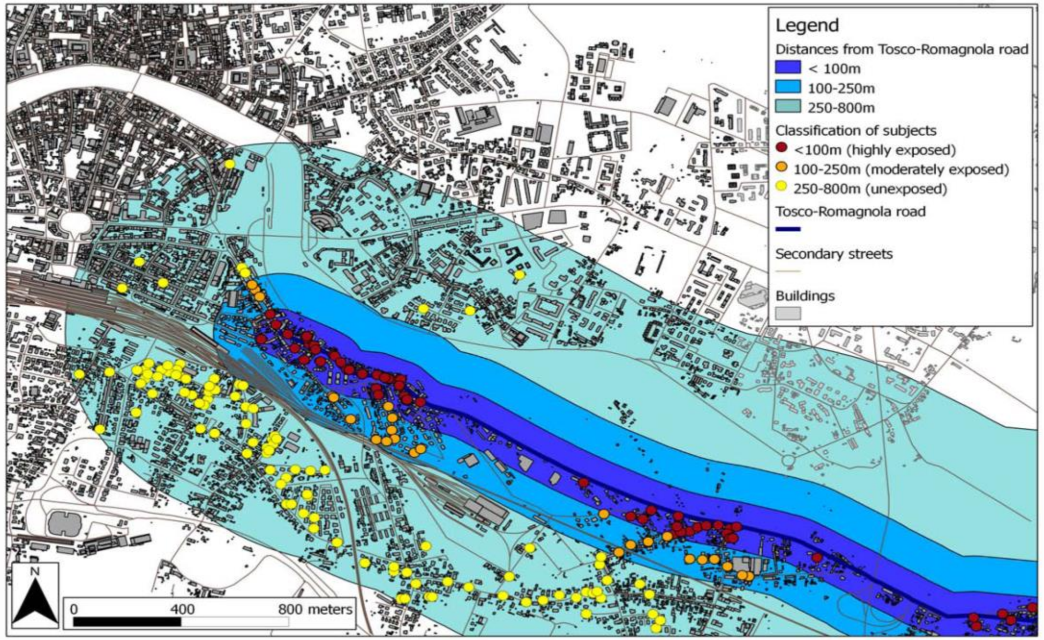



**Figure 2 Classification of subjects based on the distance of each home from the main road.** Zoomed map representing the classification of subjects according to the distance of each home from the main road. Highly exposed subjects are those living in the buffer area 0-100 m from the road, moderately exposed subjects living in the buffer area 100-250 m and unexposed are those living between 250 and 800 m from the road.

**Table 6 Effects of distance of residence to main road on respiratory symptoms/diseases and dichotomized test outcomes: OR† and 95% CI**

| | Males | | Females | |
|---|---|---|---|---|
| | <100 m | 100-250 m | <100 m | 100-250 m |
| Persistent wheeze | 1.76 * (1.08-2.87) | 1.54 # (0.94-2.53) | 1.32 (0.76-2.28) | 0.77 (0.42-1.42) |
| Dyspnea | 0.88 (0.55-1.41) | 0.86 (0.59-1.53) | 1.61 ** (1.13-2.27) | 1.35 # (0.95-1.93) |
| COPD | 1.80 * (1.03-3.08) | 1.21 (0.69-2.13) | 1.60 (0.71-3.59) | 0.99 (0.39-2.51) |
| Asthma | 1.59 (0.85-2.98) | 1.55 (0.83-2.87) | 1.68 # (0.97-2.88) | 0.58 (0.30-1.15) |
| Attacks of shortness of breath with wheeze | 1.47 (0.87-2.48) | 1.20 (0.70-2.04) | 1.67 # (0.98-2.84) | 0.74 (0.39-1.38) |
| Skin test 5 mm pos. | 1.07 (0.67-1.72) | 1.10 (0.70-1.73) | 1.83 * (1.11-3.00) | 0.95 (0.57-1.60) |
| $FEV_1/FVC\% < 70\%$ | 2.07 * (1.11-3.87) | 2.53 ** (1.42-4.53) | 1.01 (0.48-2.14) | 0.88 (0.41-1.89) |
| $FEV_1/VC\% < 70\%$ | 1.15 (0.63-2.11) | 1.76 * (1.02-3.04) | 0.84 (0.40-1.72) | 0.48 (0.21-1.11) |

† OR adjusted for age, educational level, smoking habits, passive smoking exposure, occupational exposure, working position, number of hours spent at home and time of residence, calculated with subjects living between 250-800 m as the reference group.

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, # $0.05 < p < 0.1$ (borderline).

Respiratory symptoms/diseases prevalence is still increasing: a 25-yr population study

Sara Maio [a,*], Sandra Baldacci [a], Laura Carrozzi [b], Francesco Pistelli [b], Anna Angino [a], Marzia Simoni [a], Giuseppe Sarno [a], Sonia Cerrai [a], Franca Martini [a], Martina Fresta [a], Patrizia Silvi [a], Francesco Di Pede [a], Massimo Guerriero [c], Giovanni Viegi [a,d]

Respiratory Medicine 110 (2016) 58–65

**Table 3**
Risk factors for asthma/allergic rhinitis symptoms/diagnoses: OR and 95% CI.

| | Asthma diagnosis | Attacks of asthma | Allergic rhinitis |
|---|---|---|---|
| *Survey*: | | | |
| PI1 | 1.00 | 1.00 | 1.00 |
| PI2 | 1.08 (0.94–1.25) | 0.88 (0.71–1.10) | **1.26 (1.13–1.40)** |
| PI3 | **1.34 (1.09–1.66)** | **1.90 (1.46–2.47)** | **2.98 (2.58–3.44)** |
| *Age* | 1.000 (0.991–1.001) | **1.010 (1.003–1.020)** | **0.996 (0.992–0.999)** |
| *Sex*: | | | |
| Females | 1.00 | 1.00 | 1.00 |
| Males | 1.00 (0.80–1.26) | 0.91 (0.69–1.21) | 0.90 (0.78–1.04) |
| *Work exposure*: | | | |
| No | 1.00 | 1.00 | 1.00 |
| Yes | **1.23 (1.03–1.46)** | **1.27 (1.01–1.60)** | **1.37 (1.22–1.55)** |
| *Pack-years*: | | | |
| 0 | 1.00 | 1.00 | 1.00 |
| ≤7 | 1.05 (0.82–1.36) | 1.30 (0.92–1.85) | 1.08 (0.92–1.28) |
| 8–24 | 0.97 (0.73–1.27) | 1.23 (0.86–1.74) | 0.89 (0.75–1.06) |
| ≥24 | 1.23 (0.92–1.64) | **2.04 (1.47–2.84)** | 0.88 (0.73–1.07) |
| *Educational level*: | | | |
| >13 yrs | 1.00 | 1.00 | 1.00 |
| 9-13 yrs | 0.79 (0.52–1.19) | 0.83 (0.47–1.47) | 0.88 (0.69–1.13) |
| ≤8 yrs | 1.12 (0.75–1.67) | 1.28 (0.75–2.18) | **0.75 (0.59–0.96)** |
| *Area*: | | | |
| Suburban | 1.00 | 1.00 | 1.00 |
| Urban | 0.89 (0.73–1.10) | 1.10 (0.87–1.40) | **1.19 (1.05–1.35)** |

PI1 = Pisa 1 survey; PI2 = Pisa 2 survey; PI3 = Pisa 3 survey.
OR and 95% CI from the multivariate generalised estimating equations.
Statistically significant values are represented in bold.

**Table 4**
Risk factors for COPD symptoms/diagnoses and airway obstruction°: OR and 95% CI.

| | Usual cough | Usual phlegm | COPD* | LLN airway obstruction# |
|---|---|---|---|---|
| *Survey*: | | | | |
| PI1 | 1.00 | 1.00 | 1.00 | |
| PI2 | 1.11 (0.98–1.25) | ***1.13 (0.99–1.29)*** | **1.24 (1.02–1.52)** | 1.00 |
| PI3 | 1.10 (0.93–1.30) | **1.48 (1.25–1.75)** | **1.46 (1.14–1.85)** | **1.78 (1.40–2.27)** |
| *Age* | **1.015 (1.011–1.019)** | **1.019 (1.014–1.023)** | **1.050 (1.042–1.058)** | **1.022 (1.013–1.031)** |
| *Sex*: | | | | |
| Females | 1.00 | 1.00 | 1.00 | 1.00 |
| Males | 0.94 (0.80–1.11) | **1.36 (1.15–1.61)** | **1.55 (1.17–2.05)** | 0.76 (0.57–1.01) |
| *Work exposure*: | | | | |
| No | 1.00 | 1.00 | 1.00 | 1.00 |
| Yes | **1.25 (1.10–1.44)** | **1.40 (1.22–1.62)** | **1.81 (1.46–2.24)** | 1.22 (0.95–1.57) |
| *Pack-years*: | | | | |
| 0 | 1.00 | 1.00 | 1.00 | 1.00 |
| ≤7 | **1.85 (1.51–2.27)** | **1.80 (1.44–2.24)** | 1.26 (0.83–1.91) | **1.81 (1.27–2.57)** |
| 8–23 | **2.66 (2.19–3.22)** | **2.67 (2.19–3.26)** | **2.25 (1.62–3.14)** | **2.16 (1.54–3.02)** |
| ≥24 | **4.44 (3.64–5.40)** | **4.64 (3.80–5.67)** | **4.45 (3.30–5.99)** | **2.69 (1.89–3.84)** |
| *Educational level*: | | | | |
| >13 yrs | 1.00 | 1.00 | 1.00 | 1.00 |
| 9-13 yrs | 1.25 (0.87–1.79) | 0.97 (0.70–1.37) | 1.24 (0.66–2.31) | 0.94 (0.57–1.55) |
| ≤8 yrs | **1.57 (1.11–2.21)** | 1.11 (0.80–1.53) | 1.39 (0.77–2.51) | 1.06 (0.65–1.73) |
| *Area*: | | | | |
| Suburban | 1.00 | 1.00 | 1.00 | 1.00 |
| Urban | ***1.14 (0.99–1.31)*** | **1.30 (1.12–1.49)** | **1.54 (1.25–1.90)** | 0.86 (0.67–1.11) |

PI1 = Pisa 1 survey; PI2 = Pisa 2 survey; PI3 = Pisa 3 survey.
° airway obstruction values available in PI2 and PI3 surveys.
* diagnosis of COPD or emphysema or chronic bronchitis computed only in adult subjects.
# Lower Limit of Normal (LLN) according to American Thoracic Society (ATS)/European Respiratory Society (ERS) criterion [18]: forced expiratory volume in the first second ($FEV_1$)/forced vital capacity (FVC) < 5th percentile of the predicted value.
OR and 95% CI from the multivariate generalised estimating equations.
Statistically significant values are represented in bold. Borderline values are represented in italics.

# 18-yr cumulative incidence of respiratory/allergic symptoms/diseases and risk factors in the Pisa epidemiological study

Sara Maio [a,b,*], Sandra Baldacci [a], Laura Carrozzi [c], Francesco Pistelli [d], Marzia Simoni [a], Anna Angino [a], Stefania La Grutta [e], Vito Muggeo [b], Giovanni Viegi [a,e]

**Table 4a**
Longitudinal risk factors for asthma/allergic symptom/disease incidence: OR and 95% CI.

| | Asthma diagnosis | Asthma attacks | Wheeze | Allergic rhinitis |
|---|---|---|---|---|
| Smoking habits: | | | | |
| never | 1.0 | 1.0 | 1.0 | 1.0 |
| persistent | 0.7 (0.2–3.0) | 2.7 (1.1–6.4) | 1.7 (0.6–4.7) | 0.9 (0.5–1.6) |
| remittent for <18 years | 1.1 (0.3–3.6) | 1.5 (0.6–3.8) | 0.2 (0.0–1.4) | 1.1 (0.7–1.9) |
| remittent for ≥18 years | 1.0 (0.4–2.7) | 1.4 (0.7–3.1) | 1.0 (0.4–2.6) | 1.0 (0.7–1.6) |
| incident | – | 0.9 (0.1–7.6) | 0.8 (0.1–7.1) | 0.7 (0.2–2.1) |
| Occupational exposure: | | | | |
| never | 1.0 | 1.0 | 1.0 | 1.0 |
| persistent | 4.4 (1.4–13.6) | 1.1 (0.5–2.6) | 0.5 (0.1–1.7) | 1.8 (1.1–3.0) |
| remittent | – | 0.8 (0.2–2.9) | 0.3 (0.0–2.6) | 0.7 (0.4–1.9) |
| incident | 1.8 (0.7–4.8) | 0.9 (0.5–1.9) | 1.0 (0.4–2.4) | 1.6 (1.1–2.4) |
| Vehicular traffic exposure: | | | | |
| never | 1.0 | 1.0 | 1.0 | 1.0 |
| persistent | 1.3 (0.3–5.1) | 0.6 (0.2–1.6) | 1.0 (0.3–2.9) | *1.5 (0.9–2.5)* |
| remittent | 2.4 (0.5–10.2) | 0.6 (0.2–2.2) | 0.8 (0.2–3.9) | 0.8 (0.4–1.6) |
| incident | 2.6 (0.8–8.2) | 2.2 (1.0–4.5) | 1.5 (0.6–3.7) | 1.8 (1.2–2.8) |

A logistic regression model for each considered outcome was used to estimate the effect of longitudinal changes in risk factor exposure (smoking habits, occupational exposure and vehicular traffic exposure) on respiratory symptom/disease incidence, controlling for baseline factors closely related to the onset of respiratory symptom/disease (age, sex, body mass index -BMI, passive smoking, positivity to skin prick test, family history of allergic rhinitis and family history of respiratory diseases (asthma, chronic bronchitis or emphysema)).

**Table 4b**
Longitudinal risk factors for bronchitic symptom/disease incidence: OR and 95% CI.

| | COPD | Usual phlegm | Usual cough | Dyspnoea | $AO_{LLN}$ |
|---|---|---|---|---|---|
| Smoking habits: | | | | | |
| never | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| persistent | 5.4 (2.3–12.5) | 2.9 (1.7–5.1) | 1.9 (1.0–3.5) | 1.8 (1.1–3.0) | 2.7 (1.0–7.4) |
| remittent for <18 years | 3.3 (1.4–7.7) | 0.8 (0.5–1.6) | 1.0 (0.5–1.9) | 1.5 (0.9–2.4) | 1.1 (0.4–3.4) |
| remittent for ≥18 years | 2.4 (1.2–5.1) | 1.1 (0.7–1.7) | 1.0 (0.6–1.7) | 1.3 (0.9–2.0) | 1.2 (0.5–2.8) |
| incident | – | 0.8 (0.2–3.0) | 1.7 (0.6–5.1) | 0.9 (0.3–2.8) | – |
| Occupational exposure: | | | | | |
| never | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| persistent | *1.9 (0.9–4.1)* | 1.8 (1.1–3.2) | 1.4 (0.8–2.6) | 1.3 (0.8–2.0) | 2.0 (0.8–5.2) |
| remittent | – | 0.4 (0.1–1.3) | 0.4 (0.1–1.4) | 0.8 (0.4–1.7) | 1.3 (0.3–5.4) |
| incident | 1.6 (0.9–3.0) | 1.5 (1.0–2.4) | 1.6 (1.0–2.5) | 1.9 (1.3–2.8) | 1.1 (0.5–2.6) |
| Vehicular traffic exposure: | | | | | |
| never | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| persistent | 1.7 (0.7–3.9) | 1.0 (0.6–1.7) | 0.7 (0.4–1.3) | 1.0 (0.6–1.6) | *0.4 (0.2–1.1)* |
| remittent | *2.6 (0.9–7.0)* | 1.1 (0.6–2.2) | 1.1 (0.6–2.2) | 1.0 (0.6–1.9) | 0.4 (0.1–1.8) |
| incident | 2.4 (1.1–5.2) | 1.3 (0.8–2.0) | 0.9 (0.6–1.5) | 1.2 (0.8–1.8) | 0.5 (0.2–1.2) |

A logistic regression model for each considered outcome was used to estimate the effect of longitudinal changes in risk factor exposure (smoking habits, occupational exposure and vehicular traffic exposure) on respiratory symptom/disease incidence, controlling for baseline factors closely related to the onset of respiratory symptom/disease (age, sex, body mass index -BMI, passive smoking, family history of allergic rhinitis and family history of respiratory diseases (asthma, chronic bronchitis or emphysema)).
COPD: Chronic Obstructive Pulmonary Disease; $AO_{LLN}$: Airway obstruction computed according to the lower limit of normal.
In italic: borderline values; in bold: statistically significant values.

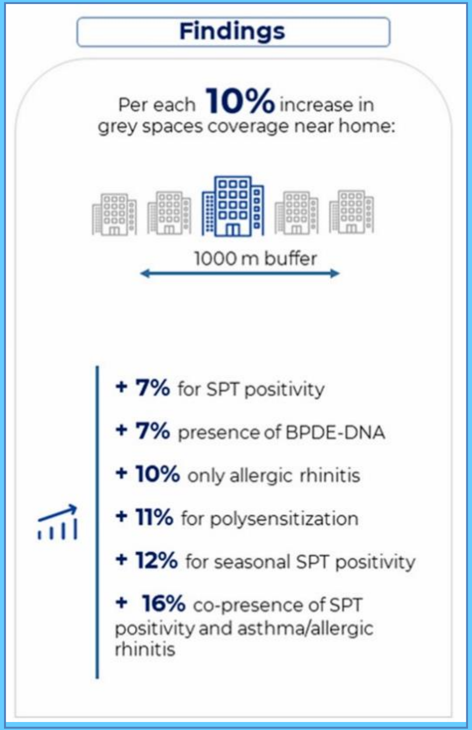
Environ Res. 2022 Apr 15;206:112428. doi: 10.1016/j.envres.2021.112428. Epub 2021 Nov 24.

# Urban grey spaces are associated with increased allergy in the general population

S Maio [1], S Baldacci [2], S Tagliaferro [2], A Angino [2], E Parmes [3], J Pärkkä [3], G Pesce [4], C N Maesano [5], I Annesi-Maesano [5], G Viegi [6]

**Table 4**
Effects of 10% increase in residential exposure to urban greyness on allergic biomarkers/conditions and serum antibodies to BPDE-DNA adducts (n = 2070).

| | OR (95% CI) |
|---|---|
| *Allergic biomarkers/conditions* | |
| SPT positivity | 1.07 (1.02–1.13) |
| Reference category: negativity | 1.00 |
| Perennial SPT positivity | 1.05 (0.98-1.12) |
| Reference category: negativity | 1.00 |
| Seasonal SPT positivity | 1.12 (1.05–1.19) |
| Reference category: negativity | 1.00 |
| Type of sensitization: | |
| polysensitization | 1.11 (1.04–1.19) |
| monosensitization | 1.03 (0.96-1.11) |
| Reference category: negativity | 1.00 |
| Asthma/allergic rhinitis co-presence: | |
| asthma & allergic rhinitis | 1.10 (0.98-1.23) |
| only allergic rhinitis | 1.10 (1.04–1.17) |
| only asthma | *1.07 (0.99-1.15)* |
| Reference category: neither asthma nor allergic rhinitis | 1.00 |
| SPT and asthma/allergic rhinitis co-presence: | |
| SPT positivity & asthma/allergic rhinitis | 1.16 (1.08–1.25) |
| only SPT positivity | 1.02 (0.95-1.09) |
| only asthma/allergic rhinitis | 1.06 (1.00–1.12) |
| Reference category: neither SPT nor asthma/allergic rhinitis | 1.00 |
| Log IgE value: | |
| ≥1.81 kU/L | 1.00 (0.95-1.05) |
| Reference category: < 1.81 kU/L | 1.00 |
| *Exposure biomarker* | |
| Positivity to serum antibodies to BPDE-DNA adducts | 1.07 (1.01–1.14) |
| Reference category: negativity | 1.00 |



INAIL
ISTITUTO NAZIONALE PER L'ASSICURAZIONE CONTRO GLI INFORTUNI SUL LAVORO

**Bando Ricerche in Collaborazione (BRiC)**
**Piano Attività di Ricerca 2016-2018**

# The project

BEEP
Bigdata in Environmental and occupational EPidemiology


June 29, 2017- December 28, 2019

http://www.progettobeep.it/index.php

## WHY BEEP

One of the big challenges of the modern environmental epidemiology is to collect and link a huge amount of heterogeneous geographic, environmental and health data to get information otherwise not available.

The General Objective of the **BEEP** project is to estimate, using **BIGDATA**, the health effects of air pollution, noise and meteorological parameters on the Italian general population, and to evaluate the risk of occupational injuries in sub-populations of workers.

The Project is structured in Specific Objectives focused on different spatial domains, from the whole national territory to the urban micro-scale. A special focus will be devoted to the risk of hospitalizations and mortality at the national level and within the major metropolitan areas, the risk of occupational injuries in relation to environmental risk factors, and the risk of road accidents related to the mobility of the population and extreme meteorological conditions.

Results provided by the **BEEP** project, in addition to address new directions in the scientific research, will provide indications to decision makers in the fields of air

## With the participation of:

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IPCF

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Regione Siciliana

ISAC

**Information: www.progettobeep.it**

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Environment International 124 (2019) 170–179

# Estimation of daily $PM_{10}$ and $PM_{2.5}$ concentrations in Italy, 2013–2015, using a spatiotemporal land-use random-forest model

Massimo Stafoggia[a,b,*], Tom Bellander[b], Simone Bucci[a], Marina Davoli[a], Kees de Hoogh[c,d], Francesca de' Donato[a], Claudio Gariazzo[e], Alexei Lyapustin[f], Paola Michelozzi[a], Matteo Renzi[a], Matteo Scortichini[a], Alexandra Shtein[g], Giovanni Viegi[h], Itai Kloog[g], Joel Schwartz[i]

Particulate matter (PM) air pollution is one of the major causes of death worldwide, with demonstrated adverse effects from both short-term and long-term exposure. Most of the epidemiological studies have been conducted in cities because of the lack of reliable spatiotemporal estimates of particles exposure in nonurban settings. The objective of this study is to estimate daily $PM_{10}$ (PM < 10 µm), fine (PM < 2.5 µm, $PM_{2.5}$) and coarse particles (PM between 2.5 and 10 µm, $PM_{2.5-10}$) at 1-km$^2$ grid for 2013–2015 using a machine learning approach, the Random Forest (RF). Separate RF models were defined to: predict $PM_{2.5}$ and $PM_{2.5-10}$ concentrations in monitors where only $PM_{10}$ data were available (stage 1); impute missing satellite Aerosol Optical Depth (AOD) data using estimates from atmospheric *ensemble* models (stage 2); establish a relationship between measured PM and satellite, land use and meteorological parameters (stage 3); predict stage 3 model over each 1-km$^2$ grid cell of Italy (stage 4); and improve stage 3 predictions by using small-scale predictors computed at the monitor locations or within a small buffer (stage 5). Our models were able to capture most of PM variability, with mean cross-validation (CV) $R^2$ of 0.75 and 0.80 (stage 3) and 0.84 and 0.86 (stage 5) for $PM_{10}$ and $PM_{2.5}$, respectively. Model fitting was less optimal for $PM_{2.5-10}$, in summer months and in southern Italy. Finally, predictions were equally good in capturing annual and daily PM variability, therefore they can be used as reliable exposure estimates for investigating long-term and short-term health effects.

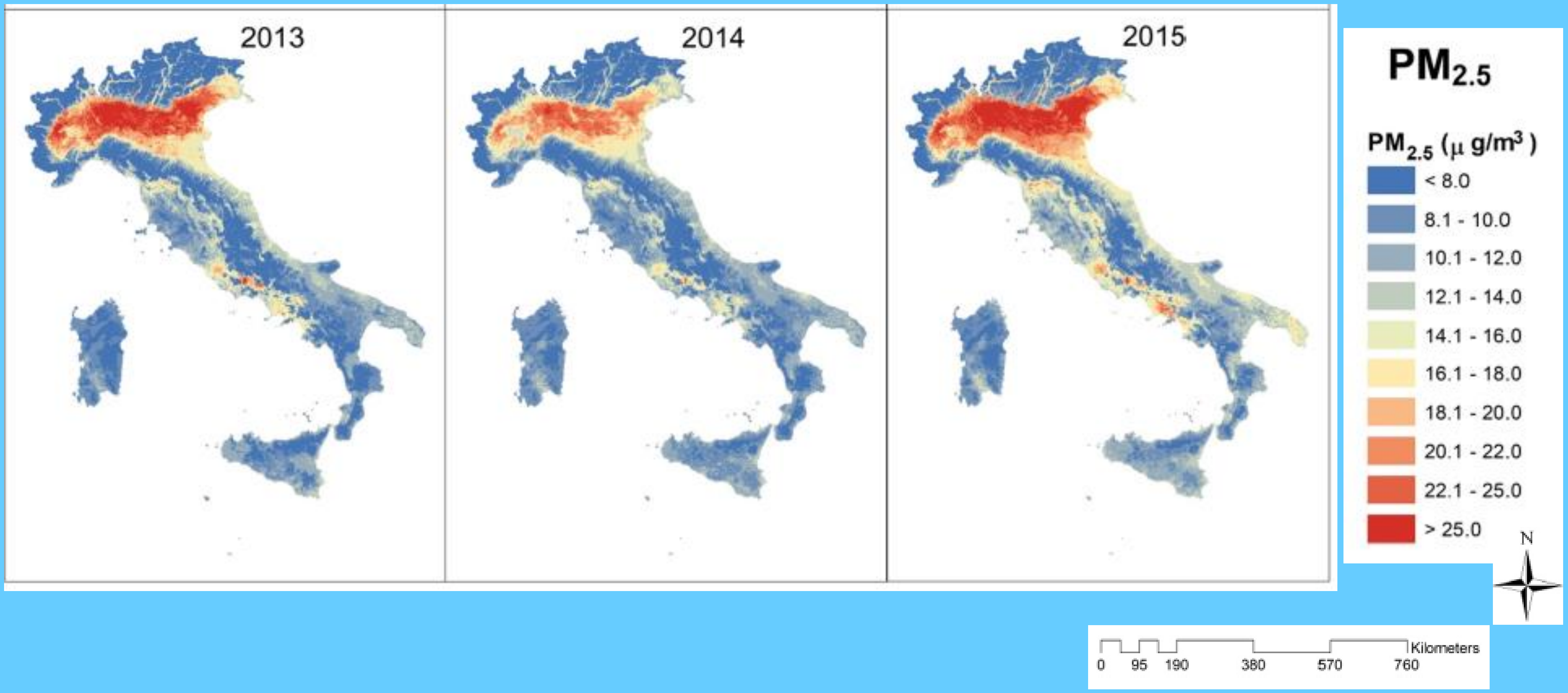



Fig. 2. Predicted $PM_{10}$ (top) and $PM_{2.5}$ (bottom) concentrations from stage 4 model: annual means, 2013–2015.

Stafoggia et al, Environ Int 2019

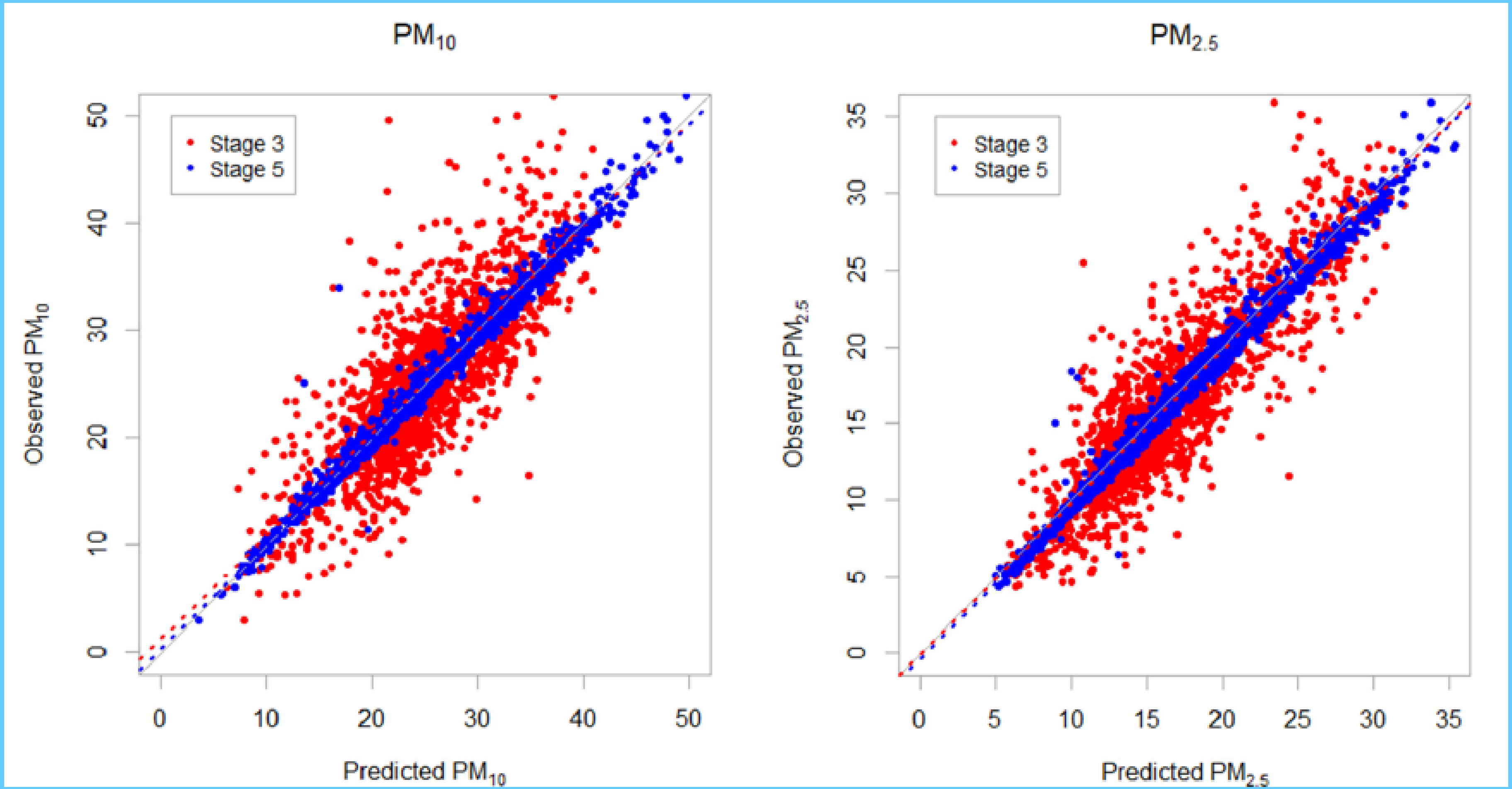



Fig. 3. $PM_{10}$ (left) and $PM_{2.5}$ (right) average concentrations ($\mu g/m^3$) at the 591 monitors available in Italy in 2013–2015: comparison between measured (y axis) and predicted concentrations from stage 3 (red dots) and stage 5 (blue dots) models. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Stafoggia et al, Environ Int 2019

# Impact of different exposure models and spatial resolution on the long-term effects of air pollution

Claudio Gariazzo [a,*], Giuseppe Carlino [b], Camillo Silibello [c], Gianni Tinarelli [c], Matteo Renzi [d], Sandro Finardi [c], Nicola Pepe [c], Daniela Barbero [c], Paola Radice [c], Alessandro Marinaccio [a], Francesco Forastiere [e,f], Paola Michelozzi [d], Giovanni Viegi [e,g], Massimo Stafoggia [d], on behalf of theBEEP Collaborative Group

Environmental Research 192 (2021) 110351

Long-term exposure to air pollution has been related to mortality in several epidemiological studies. The investigations have assessed exposure using various methods achieving different accuracy in predicting air pollutants concentrations. The comparison of the health effects estimates are therefore challenging. This paper aims to compare the effect estimates of the long-term effects of air pollutants (particulate matter with aerodynamic diameter less than 10 µm, $PM_{10}$, and nitrogen dioxide, $NO_2$) on cause-specific mortality in the Rome Longitudinal Study, using exposure estimates obtained with different models and spatial resolutions. Annual averages of $NO_2$ and $PM_{10}$ were estimated for the year 2015 in a large portion of the Rome urban area ($12 \times 12$ km$^2$) applying three modelling techniques available at increasing spatial resolution: 1) a chemical transport model (CTM) at 1km resolution; 2) a land-use random forest (LURF) approach at 200m resolution; 3) a micro-scale Lagrangian particle dispersion model (PMSS) taking into account the effect of buildings structure at 4 m resolution with results post processed at different buffer sizes (12, 24, 52, 100 and 200 m). All the exposures were assigned at the residential addresses of 482,259 citizens of Rome 30+ years of age who were enrolled on 2001 and followed-up till 2015. The association between annual exposures and natural-cause, cardiovascular (CVD) and respiratory (RESP) mortality were estimated using Cox proportional hazards models adjusted for individual and area-level confounders. We found different distributions of both $NO_2$ and $PM_{10}$ concentrations, across models and spatial resolutions. Natural cause and CVD mortality outcomes were all positively associated with $NO_2$ and $PM_{10}$ regardless of the model and spatial resolution when using a relative scale of the exposure such as the interquartile range (IQR): adjusted Hazard Ratios (HR), and 95% confidence intervals (CI), of natural cause mortality, per IQR increments in the two pollutants, ranged between 1.012 (1.004, 1.021) and 1.018 (1.007, 1.028) for the different $NO_2$ estimates, and between 1.010 (1.000, 1.020) and 1.020 (1.008, 1.031) for $PM_{10}$, with a tendency of larger effect for lower resolution exposures. The latter was even stronger when a fixed value of 10 µg/m$^3$ is used to calculate HRs. Long-term effects of air pollution on mortality in Rome were consistent across different models for exposure assessment, and different spatial resolutions.

*Int. J. Environ. Res. Public Health* **2020**, *17*, 2540

# Effects of Particulate Matter on the Incidence of Respiratory Diseases in the Pisan Longitudinal Study

**Salvatore Fasola [1,*], Sara Maio [2], Sandra Baldacci [2], Stefania La Grutta [1], Giuliana Ferrante [3], Francesco Forastiere [1], Massimo Stafoggia [4], Claudio Gariazzo [5], Giovanni Viegi [1,2] and on behalf of the BEEP Collaborative Group [†]**

**Abstract:** The current study aimed at assessing the effects of exposure to Particulate Matter (PM) on the incidence of respiratory diseases in a sub-sample of participants in the longitudinal analytical epidemiological study in Pisa, Italy. Three hundred and five subjects living at the same address from 1991 to 2011 were included. Individual risk factors recorded during the 1991 survey were considered, and new cases of respiratory diseases were ascertained until 2011. Average $PM_{10}$ and $PM_{2.5}$ exposures (μg/m$^3$, year 2011) were estimated at the residential address (1-km$^2$ resolution) through a random forest machine learning approach, using a combination of satellite data and land use variables. Multivariable logistic regression with Firth's correction was applied. The median (25th–75th percentile) exposure levels were 30.1 μg/m$^3$ (29.9–30.7 μg/m$^3$) for $PM_{10}$ and 19.3 μg/m$^3$ (18.9–19.4 μg/m$^3$) for $PM_{2.5}$. Incidences of rhinitis and chronic phlegm were associated with increasing $PM_{2.5}$: OR = 2.25 (95% CI: 1.07, 4.98) per unit increase (p.u.i.) and OR = 4.17 (1.12, 18.71) p.u.i., respectively. Incidence of chronic obstructive pulmonary disease was associated with $PM_{10}$: OR = 2.96 (1.50, 7.15) p.u.i. These results provide new insights into the long-term respiratory health effects of PM air pollution.

**Table 2.** Associations (odds ratio, OR, and 95% confidence intervals (CI)) between risk factors ascertained during the first survey (1991–1993) and cumulative incidences of asthma, rhinitis, Chronic Obstructive Pulmonary Disease (COPD) and chronic phlegm ascertained at the second survey (2009–2011), from multivariable logistic regression models with Firth's correction.

| | Asthma | Rhinitis | COPD | Chronic Phlegm |
|---|---|---|---|---|
| Cumulative incidence: | 4/284 (1.4%) | 90/264 (34.1%) | 29/282 (10.3%) | 16/262 (6.1%) |
| Independent variables: | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| $PM_{10}$ (1 $\mu g/m^3$ increase) [1] | - [2] | - [2] | **2.96 (1.50–7.15)** | - [2] |
| $PM_{2.5}$ (1 $\mu g/m^3$ increase) [1] | - [2] | **2.25 (1.07–4.98)** | - [2] | **4.17 (1.12–18.71)** |
| Age, years (10-year increase) | - [2] | - [2] | **1.87 (1.29–3.02)** | - [2] |
| Male gender | - [2] | - [2] | - [2] | - [2] |
| Smoker (ref = non-smoker) | **12.96 (1.25–∞)** | - [2] | **2.99 (1.08–9.39)** | - [2] |
| Ex-smoker (ref = non-smoker) | 4.86 (0.27–∞) | - [2] | 1.67 (0.60–4.89) | - [2] |
| Occupational exposure | - [2] | - [2] | 1.91 (0.83–4.79) | **5.41 (1.88–21.79)** |

[1] Estimated exposure levels at the residential address for the year 2011, 1 $km^2$ resolution. [2] Variables excluded by the stepwise selection procedure. Significant odds ratios are reported in bold.

Fasola, Int J Environ Res Public Health 2020

# Short-Term Effects of Air Pollution on Cardiovascular Hospitalizations in the Pisan Longitudinal Study

Salvatore Fasola [1,*,†], Sara Maio [2,†], Sandra Baldacci [2], Stefania La Grutta [1], Giuliana Ferrante [3], Francesco Forastiere [1], Massimo Stafoggia [4], Claudio Gariazzo [5], Camillo Silibello [6], Giuseppe Carlino [7], Giovanni Viegi [1,2] and on behalf of the BEEP Collaborative Group [†]

*Int. J. Environ. Res. Public Health* **2021**, *18*, 1164.

**Abstract:** Air pollution effects on cardiovascular hospitalizations in small urban/suburban areas have been scantly investigated. Such effects were assessed among the participants in the analytical epidemiological survey carried out in Pisa and Cascina, Tuscany, Italy (2009–2011). Cardiovascular hospitalizations from 1585 subjects were followed up (2011–2015). Daily mean pollutant concentrations were estimated through random forests at 1 km (particulate matter: $PM_{10}$, 2011–2015; $PM_{2.5}$, 2013–2015) and 200 m ($PM_{10}$, $PM_{2.5}$, $NO_2$, $O_3$, 2013–2015) resolutions. Exposure effects were estimated using the case-crossover design and conditional logistic regression (odds ratio—OR—and 95% confidence interval—CI—for 10 μg/m$^3$ increase; lag 0–6). During the period 2011–2015 (137 hospitalizations), a significant effect at lag 0 was observed for $PM_{10}$ (OR = 1.137, CI: 1.023–1.264) at 1 km resolution. During the period 2013–2015 (69 hospitalizations), significant effects at lag 0 were observed for $PM_{10}$ (OR = 1.268, CI: 1.085–1.483) and $PM_{2.5}$ (OR = 1.273, CI: 1.053–1.540) at 1 km resolution, as well as for $PM_{10}$ (OR = 1.365, CI: 1.103–1.690), $PM_{2.5}$ (OR = 1.264, CI: 1.006–1.589) and $NO_2$ (OR = 1.477, CI: 1.058–2.061) at 200 m resolution; significant effects were observed up to lag 2. Larger ORs were observed in males and in subjects reporting pre-existent cardiovascular/respiratory diseases. Combining analytical and routine epidemiological data with high-resolution pollutant estimates provides new insights on acute cardiovascular effects in the general population and in potentially susceptible subgroups living in small urban/suburban areas.

ELSEVIER

Science of The Total Environment
Available online 17 October 2021, 151034
In Press, Journal Pre-proof

2022 Feb 10;807(Pt 3):151034.

# A nationwide study of air pollution from particulate matter and daily hospitalizations for respiratory diseases in Italy

Matteo Renzi [a], Matteo Scortichini [a], Francesco Forastiere [b, e], Francesca de' Donato [a], Paola Michelozzi [a], Marina Davoli [a], Claudio Gariazzo [c], Giovanni Viegi [b, d], Massimo Stafoggia [a], BEEP collaborative Group, Carla Ancona [f], Simone Bucci [f], Francesca de' Donato [f], Paola Michelozzi [f], Matteo Renzi [f], Matteo Scortichini [f], Massimo Stafoggia [f], Michela Bonafede [g] ... Giuseppe Carlino [s]

## Abstract

### Background/aim

The relationship between air pollution and respiratory morbidity has been widely addressed in urban and metropolitan areas but little is known about the effects in non-urban settings. Our aim was to assess the short-term effects of PM10 and PM2.5 on respiratory admissions in the whole country of Italy during 2006–2015.

### Methods

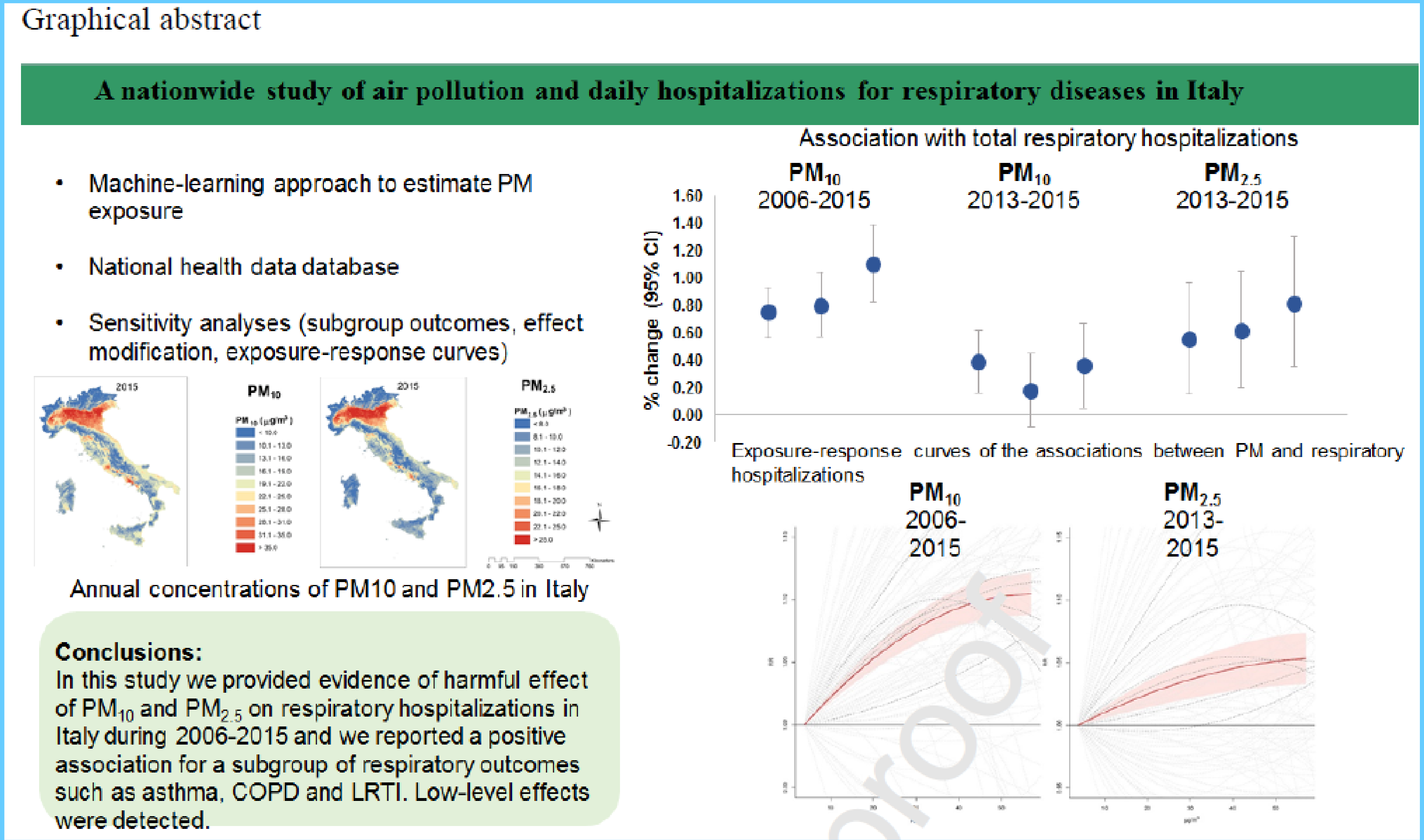
We estimated daily PM concentrations at the municipality level using satellite data and spatiotemporal predictors. We collected daily counts of respiratory hospital admissions for each Italian municipality. We considered five different outcomes: all respiratory diseases, asthma, chronic obstructive pulmonary disease (COPD), lower and upper respiratory tract infections (LRTI and URTI). Meta-analysis of province-specific estimates obtained by time-series models, adjusting for temperature, humidity and other confounders, was applied to extrapolate national estimates for each outcome. At last, we tested for effect modification by sex, age, period, and urbanization score. Analyses for $PM_{2.5}$ were restricted to 2013–2015 cause the goodness of fit of exposure estimation.

### Results

A total of 4,154,887 respiratory admission were registered during 2006–2015, of which 29% for LRTI, 12% for COPD, 6% for URTI, and 3% for asthma. Daily mean $PM_{10}$ and $PM_{2.5}$ concentrations over the study period were 23.3 and 17 μg/m$^3$, respectively. For each 10 μg/m$^3$ increases in $PM_{10}$ and $PM_{2.5}$ at lag 0–5 days, we found excess risks of total respiratory diseases equal to 1.20% (95% confidence intervals, 0.92, 1.49) and 1.22% (0.76, 1.68), respectively. The effects for the specific diseases were similar, with the strongest ones for asthma and COPD. Higher effects were found in the elderly and in less urbanized areas.

### Conclusions

Short-term exposure to PM is harmful for the respiratory system throughout an entire country, especially in elderly patients. Strong effects can be found also in less urbanized areas.




Renzi, Sci Total Environ 2022

GARD Italy — UN MONDO DOVE RESPIRARE LIBERAMENTE

*Novembre 2019*

# INQUINAMENTO ATMOSFERICO E CAMBIAMENTI CLIMATICI

## Elementi per una strategia nazionale di prevenzione

**GARD ITALIA**

*Sottogruppo di lavoro "Ambiente, Clima e Salute"*

*Ministero della Salute*
*Direzione Generale della Prevenzione Sanitaria*

**https://www.salute.gov.it/imgs/C_17_pubblicazioni_2945_allegato.pdf**

## COMPONENTI DEL SOTTOGRUPPO

Annamaria de Martino [1], Stefania La Grutta [2], Guglielmo Bruno [3], Lorenzo Cecchi [4], Vincenzo Cilenti [5], Gennaro D'Amato [6], Salvatore D'Antonio [7], Claudio Donner F. [5], Fausta Franchi [7], Giada Adamo [8], Stefania Romano [8], Sandra Frateiacci [9], Claudio Maria Sanguinetti [10], Carlo Mereu [11], Maria Teresa Ventura,[12] Luciana Indinnimeo [13], Giovanni Viegi [14].

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Hanno inoltre collaborato alla stesura del documento:
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Sara Bozzetto, Valeria Caldarelli, Antonino Francesco Capizzi, Maria Elisa Di Cicco, Giuliana Ferrante, Michele Ghezzi, in qualità di Junior Member SIMRI (JMs).

# INDICE

Sottogruppo GARD-I
"Ambiente, Clima e Salute"

Presentazione

# NUOVE EVIDENZE A SUPPORTO DEL DOCUMENTO "INQUINAMENTO ATMOSFERICO E CAMBIAMENTI CLIMATICI

GARD Italy UN MONDO DOVE RESPIRARE LIBERAMENTE

## Elementi per una strategia nazionale di prevenzione"

## Aggiornamento 2023


Il sottogruppo di lavoro GARD-Italia che ha curato l'aggiornamento risulta così composto:

**Fabrizio Anatra** - Ministero della Salute -Direzione Generale della Prevenzione Sanitaria

**Gennaro D'Amato** - AIPO-ITS

**Francesca De Maio** - ISPRA -Istituto Superiore Protezione e Ricerca Ambientale

**Daniela Galeone** - Ministero della Salute -Direzione Generale della Prevenzione Sanitaria

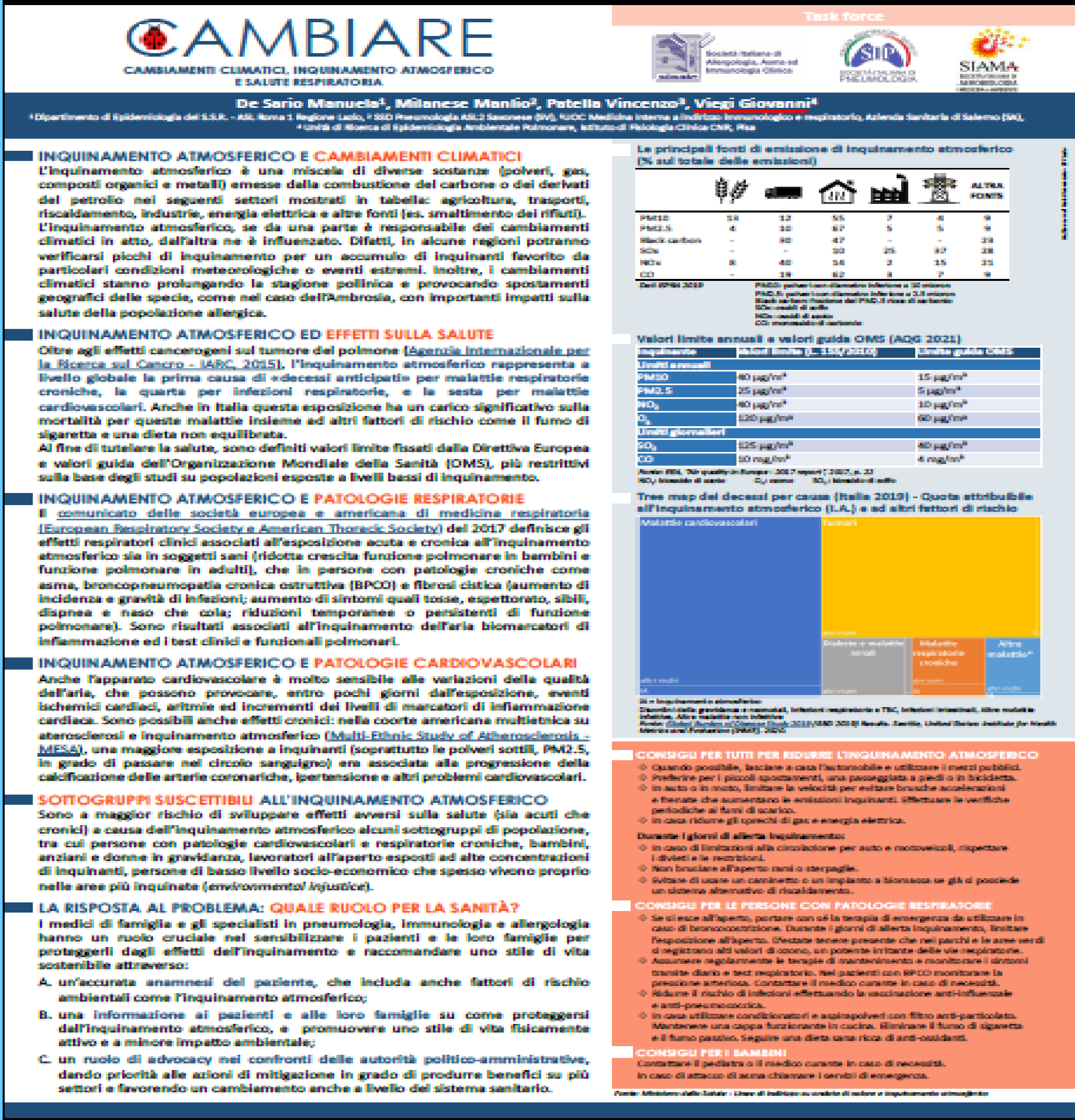
**Paolo Lauriola** - ISDE

**Giovanni Viegi** - CNR e GARD Internazionale

CAMBIARE

CAMBIAMENTI CLIMATICI, INQUINAMENTO ATMOSFERICO E SALUTE RESPIRATORIA

https://www.sipirs.it/cms/wp-content/uploads/2022/11/POSTER_CAMBIARE.pdf



# CAMBIARE

CAMBIAMENTI CLIMATICI, INQUINAMENTO ATMOSFERICO E SALUTE RESPIRATORIA

Task force


De Sario Manuela[1], Milanese Manlio[2], Patella Vincenzo[3], Viegi Giovanni[4]

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## INQUINAMENTO ATMOSFERICO E CAMBIAMENTI CLIMATICI

L'inquinamento atmosferico è una miscela di diverse sostanze (polveri, gas, composti organici e metalli) emesse dalla combustione del carbone o dei derivati del petrolio nei seguenti settori mostrati in tabella: agricoltura, trasporti, riscaldamento, industrie, energia elettrica e altre fonti (es. smaltimento dei rifiuti).
L'inquinamento atmosferico, se da una parte è responsabile dei cambiamenti climatici in atto, dall'altra ne è influenzato. Difatti, in alcune regioni potranno verificarsi picchi di inquinamento per un accumulo di inquinanti favorito da particolari condizioni meteorologiche o eventi estremi. Inoltre, i cambiamenti climatici stanno prolungando la stagione pollinica e provocando spostamenti geografici delle specie, come nel caso dell'Ambrosia, con importanti impatti sulla salute della popolazione allergica.

## INQUINAMENTO ATMOSFERICO ED EFFETTI SULLA SALUTE

Oltre agli effetti cancerogeni sul tumore del polmone (Agenzia Internazionale per la Ricerca sul Cancro - IARC, 2015), l'inquinamento atmosferico rappresenta a livello globale la prima causa di «decessi anticipati» per malattie respiratorie croniche, la quarta per infezioni respiratorie, e la sesta per malattie cardiovascolari. Anche in Italia questa esposizione ha un carico significativo sulla mortalità per queste malattie insieme ad altri fattori di rischio come il fumo di sigaretta e una dieta non equilibrata.
Al fine di tutelare la salute, sono definiti valori limite fissati dalla Direttiva Europea e valori guida dell'Organizzazione Mondiale della Sanità (OMS), più restrittivi sulla base degli studi su popolazioni esposte a livelli bassi di inquinamento.

## INQUINAMENTO ATMOSFERICO E PATOLOGIE RESPIRATORIE

Il comunicato delle società europea e americana di medicina respiratoria (European Respiratory Society e American Thoracic Society) del 2017 definisce gli effetti respiratori clinici associati all'esposizione acuta e cronica all'inquinamento atmosferico sia in soggetti sani (ridotta crescita funzione polmonare in bambini e funzione polmonare in adulti), che in persone con patologie croniche come asma, broncopneumopatia cronica ostruttiva (BPCO) e fibrosi cistica (aumento di incidenza e gravità di infezioni; aumento di sintomi quali tosse, espettorato, sibili, dispnea e naso che cola; riduzioni temporanee o persistenti di funzione polmonare). Sono risultati associati all'inquinamento dell'aria biomarcatori di infiammazione ed i test clinici e funzionali polmonari.

## INQUINAMENTO ATMOSFERICO E PATOLOGIE CARDIOVASCOLARI

Anche l'apparato cardiovascolare è molto sensibile alle variazioni della qualità dell'aria, che possono provocare, entro pochi giorni dall'esposizione, eventi ischemici cardiaci, aritmie ed incrementi dei livelli di marcatori di infiammazione cardiaca. Sono possibili anche effetti cronici: nella coorte americana multietnica su aterosclerosi e inquinamento atmosferico (Multi-Ethnic Study of Atherosclerosis - MESA), una maggiore esposizione a inquinanti (soprattutto le polveri sottili, PM2.5, in grado di passare nel circolo sanguigno) era associata alla progressione della calcificazione delle arterie coronariche, ipertensione e altri problemi cardiovascolari.

## SOTTOGRUPPI SUSCETTIBILI ALL'INQUINAMENTO ATMOSFERICO

Sono a maggior rischio di sviluppare effetti avversi sulla salute (sia acuti che cronici) a causa dell'inquinamento atmosferico alcuni sottogruppi di popolazione, tra cui persone con patologie cardiovascolari e respiratorie croniche, bambini, anziani e donne in gravidanza, lavoratori all'aperto esposti ad alte concentrazioni di inquinanti, persone di basso livello socio-economico che spesso vivono proprio nelle aree più inquinate (*environmental injustice*).

## LA RISPOSTA AL PROBLEMA: QUALE RUOLO PER LA SANITÀ?

I medici di famiglia e gli specialisti in pneumologia, immunologia e allergologia hanno un ruolo cruciale nel sensibilizzare i pazienti e le loro famiglie per proteggerli dagli effetti dell'inquinamento e raccomandare uno stile di vita sostenibile attraverso:

A. un'accurata anamnesi del paziente, che includa anche fattori di rischio ambientali come l'inquinamento atmosferico;
B. una informazione ai pazienti e alle loro famiglie su come proteggersi dall'inquinamento atmosferico, e promuovere uno stile di vita fisicamente attivo e a minore impatto ambientale;
C. un ruolo di advocacy nei confronti delle autorità politico-amministrative, dando priorità alle azioni di mitigazione in grado di produrre benefici su più settori e favorendo un cambiamento anche a livello del sistema sanitario.

### Le principali fonti di emissione di inquinamento atmosferico (% sul totale delle emissioni)

| | | | | | | ALTRE FONTI |
|---|---|---|---|---|---|---|
| PM10 | 16 | 12 | 55 | 7 | 6 | 9 |
| PM2.5 | 4 | 10 | 67 | 5 | 5 | 9 |
| Black carbon | – | 30 | 47 | – | – | 23 |
| SOx | – | – | 10 | 25 | 37 | 28 |
| NOx | 8 | 40 | 16 | 2 | 15 | 21 |
| CO | – | 19 | 62 | 8 | 7 | 9 |

### Valori limite annuali e valori guida OMS (AQG 2021)

| Inquinante | Valori limite (D. Lgs 155/2010) | Valori guida OMS |
|---|---|---|
| Limiti annuali | | |
| PM10 | 40 µg/m³ | 15 µg/m³ |
| PM2.5 | 25 µg/m³ | 5 µg/m³ |
| $NO_2$ | 40 µg/m³ | 10 µg/m³ |
| $O_3$ | 120 µg/m³ | 60 µg/m³ |
| Limiti giornalieri | | |
| $SO_2$ | 125 µg/m³ | 40 µg/m³ |
| CO | 10 mg/m³ | 4 mg/m³ |

### Tree map dei decessi per causa (Italia 2019) - Quota attribuibile all'inquinamento atmosferico (I.A.) e ad altri fattori di rischio

Malattie cardiovascolari | Tumori | Diabete e malattie renali | Malattie respiratorie croniche | Altre malattie

### CONSIGLI PER TUTTI PER RIDURRE L'INQUINAMENTO ATMOSFERICO

- Quando possibile, lasciare a casa l'automobile e utilizzare i mezzi pubblici.
- Preferire per i piccoli spostamenti, una passeggiata a piedi o in bicicletta.
- In auto o in moto, limitare la velocità per evitare brusche accelerazioni e frenate che aumentano le emissioni inquinanti. Effettuare le verifiche periodiche ai fumi di scarico.
- In casa ridurre gli sprechi di gas e energia elettrica.

Durante i giorni di allerta inquinamento:

- In caso di limitazioni alla circolazione per auto e motoveicoli, rispettare i divieti e le restrizioni.
- Non bruciare all'aperto rami o sterpaglie.
- Evitare di usare un caminetto o un impianto a biomassa se già si possiede un sistema alternativo di riscaldamento.

### CONSIGLI PER LE PERSONE CON PATOLOGIE RESPIRATORIE

- Se si esce all'aperto, portare con sé la terapia di emergenza da utilizzare in caso di broncocostrizione. Durante i giorni di allerta inquinamento, limitare l'esposizione all'aperto. D'estate tenere presente che nei parchi e le aree verdi si registrano alti valori di ozono, un potente irritante delle vie respiratorie.
- Assumere regolarmente le terapie di mantenimento e monitorare i sintomi tramite diario e test respiratorio. Nei pazienti con BPCO monitorare la pressione arteriosa. Contattare il medico curante in caso di necessità.
- Ridurre il rischio di infezioni effettuando la vaccinazione anti-influenzale e anti-pneumococcica.
- In casa utilizzare condizionatori e aspirapolveri con filtro anti-particolato. Mantenere una cappa funzionante in cucina. Eliminare il fumo di sigaretta e il fumo passivo. Seguire una dieta sana ricca di anti-ossidanti.

### CONSIGLI PER I BAMBINI

Contattare il pediatra o il medico curante in caso di necessità.
In caso di attacco di asma chiamare i servizi di emergenza.

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EDITORIAL

# A series of narrative reviews on air pollution and respiratory health for Pulmonology: Why it is important and who should read it

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REVIEW

# Issue 1 - "Update on adverse respiratory effects of outdoor air pollution". Part 1): Outdoor air pollution and respiratory diseases: A general update and an Italian perspective

S. De Matteis[a,b], F. Forastiere[c,d], S. Baldacci[e], S. Maio[e], S. Tagliaferro[e], S. Fasola[d], G. Cilluffo[d], S. La Grutta[d], G. Viegi[d,e,*]

Abstract

*Objective:* to summarize the main updated evidence about the health effects of air pollution and to focus on Italian epidemiological experiences on the respiratory effects.

*Results:* the recent literature indicates that there is strong evidence for causal relationships between $PM_{2.5}$ air pollution exposure and all-cause mortality as well as mortality from acute lower respiratory infections, ischaemic heart disease, stroke, chronic obstructive pulmonary disease, and lung cancer. A growing body of evidence also suggests causal relationships with type II diabetes and impacts on neonatal mortality from low birth weight and short gestation as well as neurologic effects in both children and adults. Italy, a Southern European country, faces a more threatening air pollution challenge because of the effects of both anthropogenic pollutants and natural dust (particulate matter, PM). The 2020 Report of the European Environment Agency highlighted the number of premature deaths in Italy attributable to main pollutants: 52,300 for $PM_{2.5}$, 10,400 for $NO_2$ and 3,000 for $O_3$ in 2018. In Italy, original time series and analytical epidemiological studies showed increased cardio-respiratory hospital admissions and mortality and increased risk of respiratory diseases in people living in urban areas.

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# Outdoor air pollution and respiratory health

S. Maio, G. Sarno, S. Tagliaferro, F. Pirona, I. Stanisci, S. Baldacci, G. Viegi

The need to address the impact of air pollution on health is reinforced by recent scientific evidence and the 2021 WHO Air Quality Guidelines (AQG). Air pollution is an avoidable risk factor causing a high burden for society with elevated deaths, health disorders, disabilities and huge socio-economic costs, especially in low- and middle-income countries. We have evaluated recent evidence from international reports, systematic reviews and official websites of international agencies. Growing evidence shows a causal relationship between air pollution exposure and acute lower respiratory infections, chronic obstructive pulmonary disease, asthma and lung cancer. Exposure to air pollution in both the short- and long-term has a serious impact on respiratory health. Harmful effects occur even at very low pollutant concentration levels, and there are no detectable thresholds below which exposure may be considered safe. The adverse respiratory health effects of air pollutants, even at low levels, are confirmed by recent epidemiological studies. Scientific respiratory societies and patient associations, along with other stakeholders in the health sector, should increase their engagement and advocacy to raise awareness of clean air policies and the latest WHO AQG.

KEY WORDS: particulate matter; $PM_{2.5}$; $PM_{10}$; asthma; COPD

“Molte grazie per l’invite e l’attenzione”.

Giovanni Viegi

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