Congresso nazionale ISDE Italia 2023

Inquinamento atmosferico e mutamenti climatici: ruolo del medico imparziale ma non neutrale

20, 21 e 22 Ottobre 2023

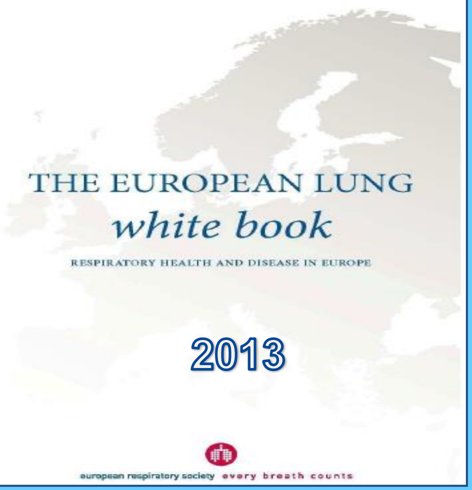
Auditorium Sede Direzionale Aboca - Loc. Aboca,20 - 52037 Sansepolcro (AR)

Effetti respiratori dell'inquinamento atmosferico e aggiornamento del documento GARD-Italia del 2019

Giovanni Viegi, MD, FERS, ATSF

Retired CNR Director of Research
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: 15'



92-99% of the world population overexposed with respect to the 2021 WHO Air Quality Guidelines

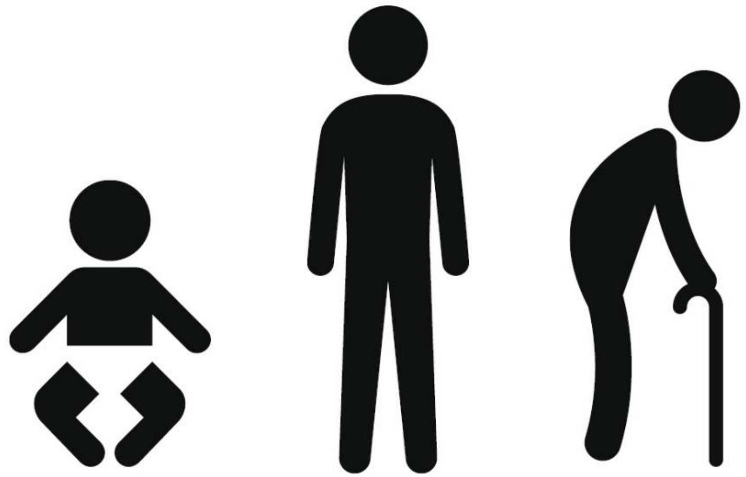

EurRespir J 2021

EDITORIAL
AIR POLLUTION

CrossMark

The clear and persistent impact of air pollution on chronic respiratory diseases: a call for interventions

Isabella Annesi-Maesano[1], Francesco Forastiere[2], John Balmes[3,4,5], Erika Garcia[6], Jack Harkema[7], Stephen Holgate[8], Frank Kelly[2], Haneen Khreis[9], Barbara Hoffmann[10], Cara Nichole Maesano[1], Rob McConnell[11], David Peden[12], Kent Pinkerton[13], Tamara Schikowski[14], George Thurston[15], Laura S. Van Winkle[16] and Christopher Carlsten[17]



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

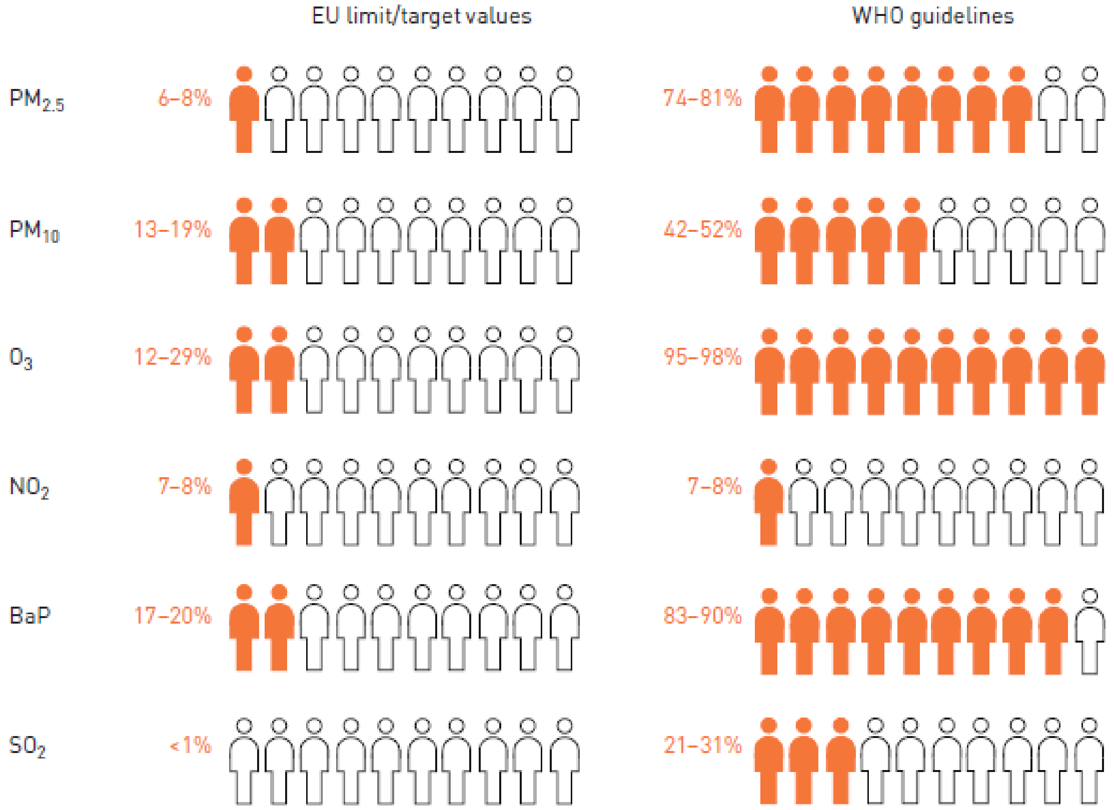
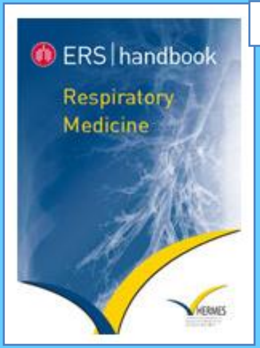


FIGURE 1 Exceedance of air quality standards and guidelines in European urban areas (data from www.eea.europa.eu/themes/air/health-impacts-of-air-pollution). WHO: World Health Organization; $PM_{2.5}$: particulate matter of diameter of 2.5 μm, PM_{10}: particulate matter of diameter of 10 μm; BaP: benzo[a]pyrene. EU reference values (annual value): $PM_{2.5}$: 25 μg·m^{-3}, PM_{10}: 40 μg·m^{-3}, NO_2: 40 μg·m^{-3}, O_3: 120 μg·m^{-3} (8-h mean); SO_2: 125 μg·m^{-3} (24-h mean); BaP: 1 ng·m^{-3}. WHO air quality guidelines: EU reference values (annual value): $PM_{2.5}$: 10 μg·m^{-3}, PM_{10}: 20 μg·m^{-3}, NO_2: 40 μg·m^{-3}, O_3: 100 μg·m^{-3} (8-h mean); SO_2: 20 μg·m^{-3} (24-h mean); BaP: 0.12 ng·m^{-3}.



9/4/13

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 Vehicular traffic Organic matter and fossil fuel combustion Power stations/industry Windblown dust from roadways, agriculture and construction Bushfires/dust storms Indoor Woodstoves Organic matter and fossil fuel combustion for heating/cooking ETS	Lung cancer Premature death Mortality for cardiorespiratory diseases Reduced lung function Lower airway inflammation Upper airways irritation Neurological, cardiovascular diseases, metabolic disorders
Nitrogen dioxide	Outdoor Vehicular traffic Power stations/industry Indoor Unvented gas/kerosene appliances	Exacerbation of asthma Airway inflammation Bronchial hyperresponsiveness Increased susceptibility to respiratory infection Reduced lung function
Ozone	Outdoor Sunlight chemical reaction with other pollutants Vehicular traffic Power stations/industry Consumer products	Lung tissue damage Reduced lung function Reduced exercise capacity Exacerbation of asthma Upper airway and eye irritation
Carbon monoxide	Outdoor Organic matter and fossil fuel combustion Vehicular traffic Domestic heating Indoor Organic matter and fossil fuel combustion for heating/cooking Woodstoves Unvented gas/kerosene appliances ETS	Death/coma at very high levels Headache, nausea, breathlessness, confusion/reduced mental alertness Low birth weight (fetal exposure)
Sulfur dioxide	Outdoor Coal/oil-burning power stations Industry/refineries Diesel engines Metal smelting	Exacerbation of respiratory diseases including asthma Respiratory tract irritation
VOCs	Indoor Building materials and products such as new furniture, solvents, paint, adhesives, insulation Cleaning activities and products Materials for offices	Lung cancer Asthma, dizziness, respiratory and lung diseases Chronic eye, lung or skin irritation Neurological and reproductive disorders

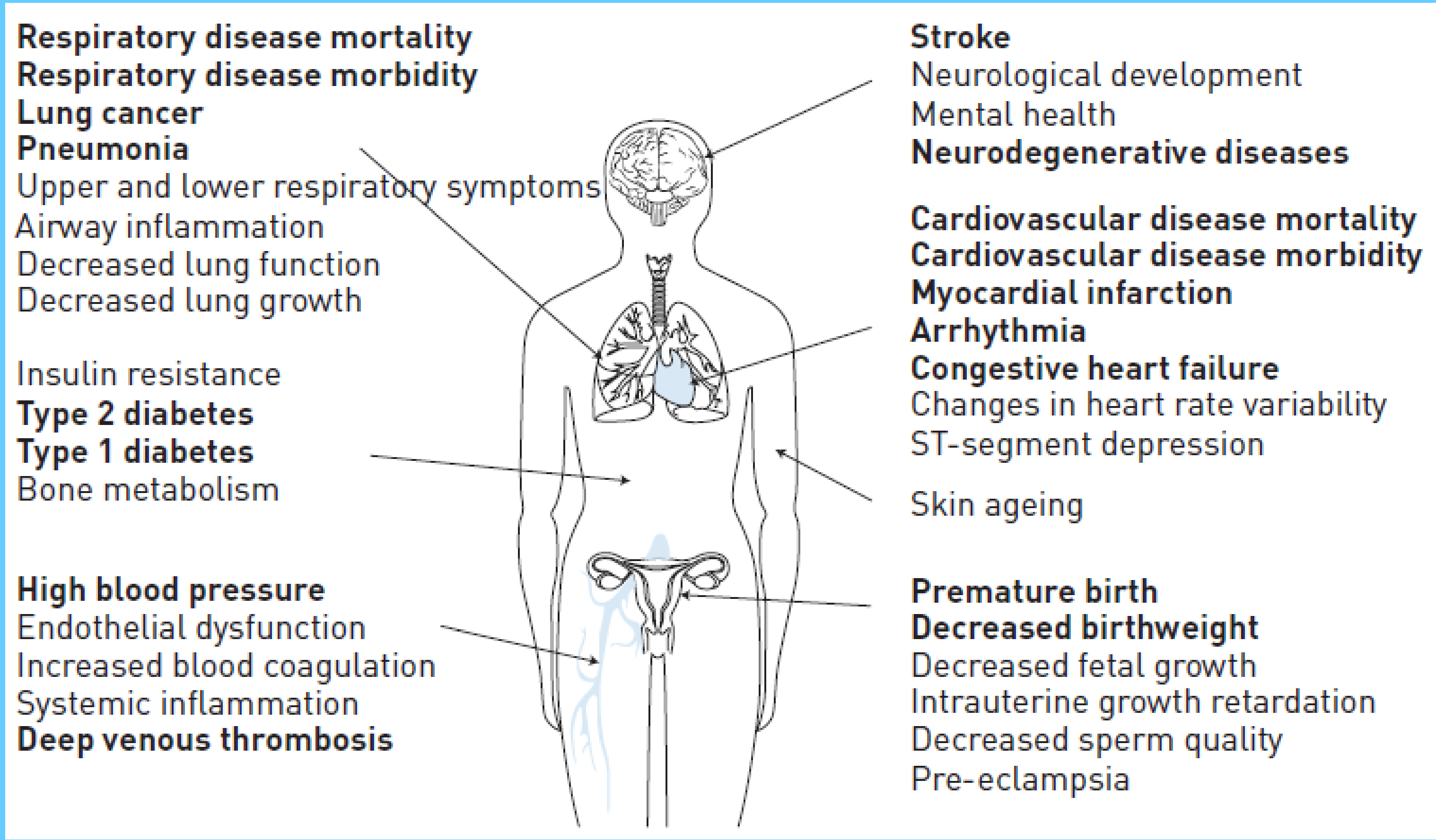
Viegi G, et al. Indoor and outdoor pollution. In "ERS Handbook, Respiratory Medicine 3rd Edition", Palange P, Rohde G eds., European Respiratory Society, Sheffield (UK) 2019: pp 771-778.

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.



Newer evidences:

Interstitial Pulmonary Fibrosis

- Exacerbations
- Incidence (?)

Cystic fibrosis

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.

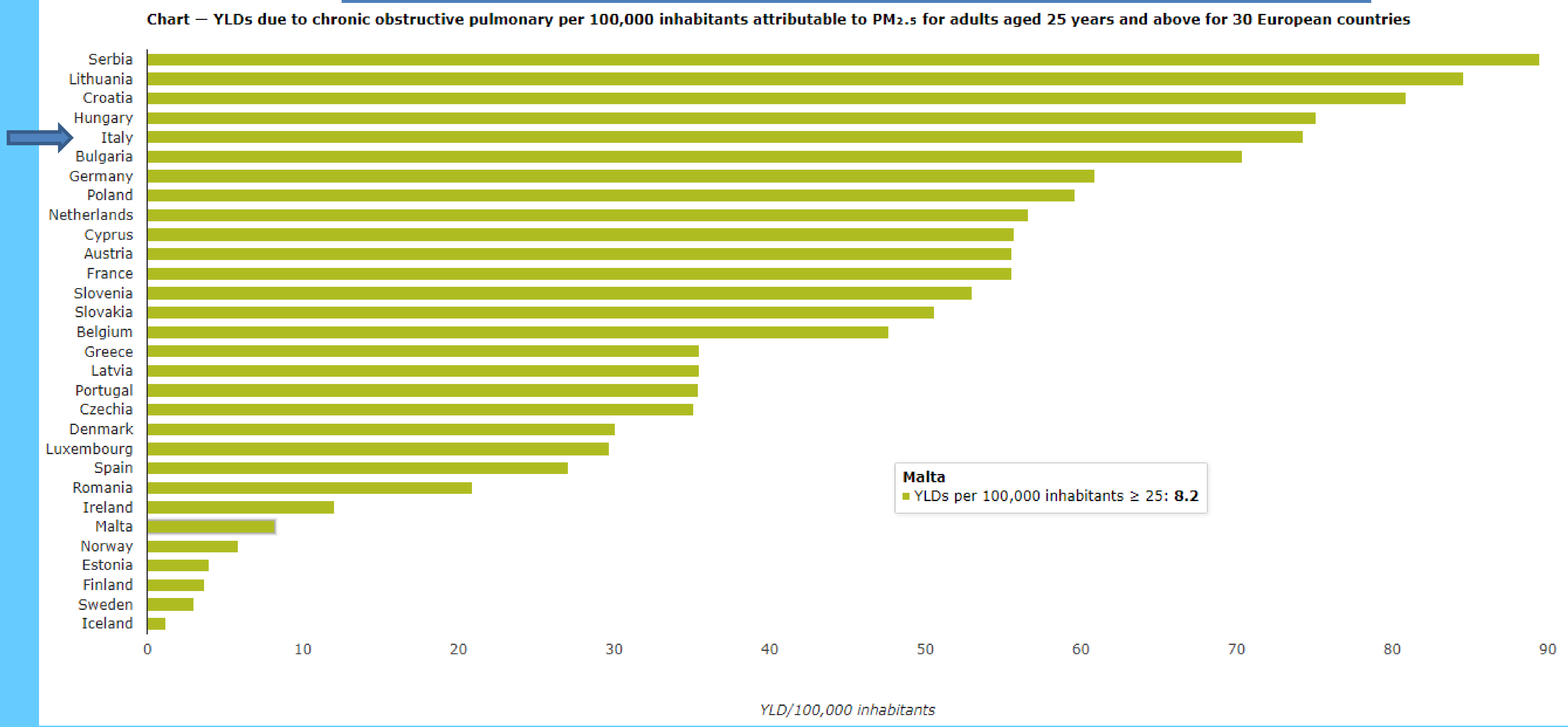
TABLE 4 Examples of biomarkers of potentially adverse respiratory health effects

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

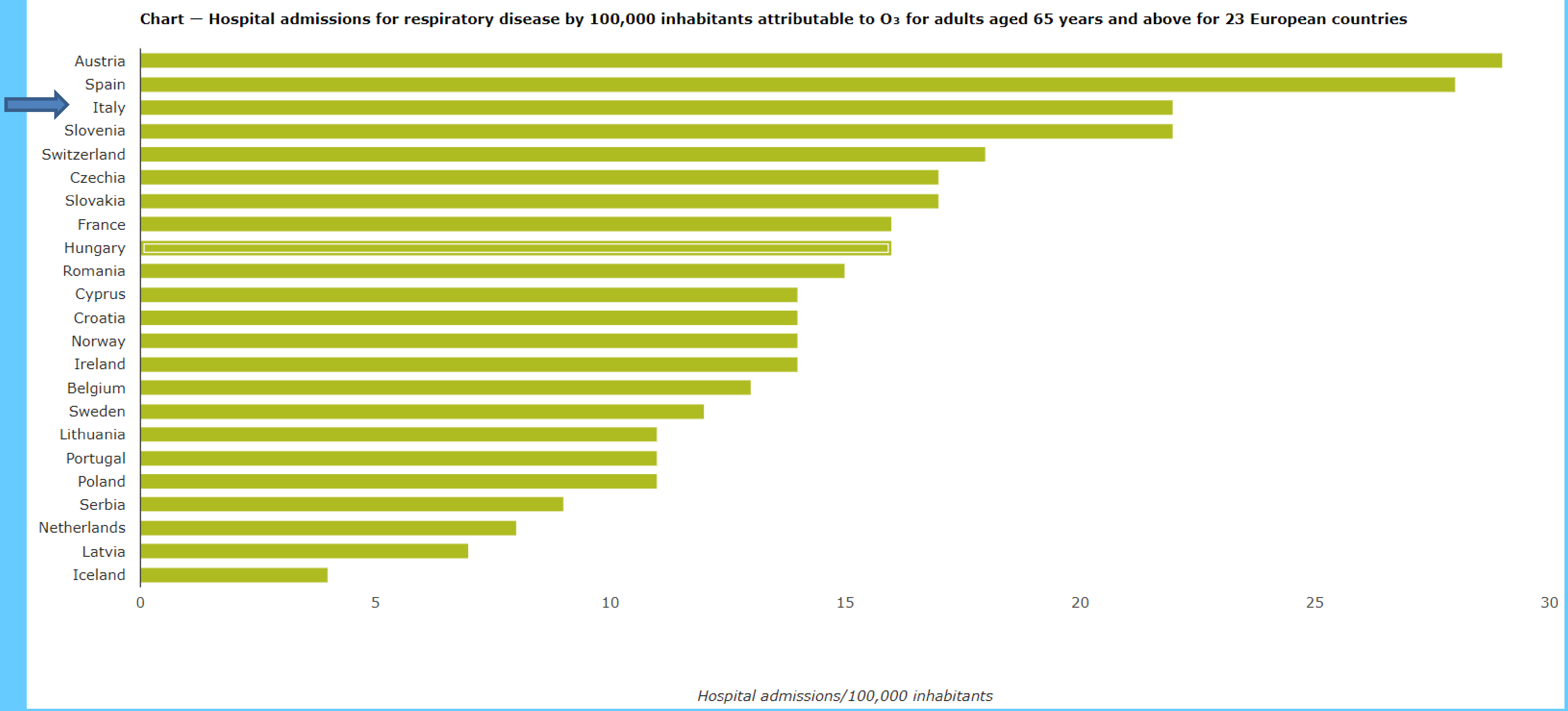
Figure 2. YLDs due to chronic obstructive pulmonary disease per 100,000 inhabitants attributable to $PM_{2.5}$ for adults aged 25 and above for 30 European



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



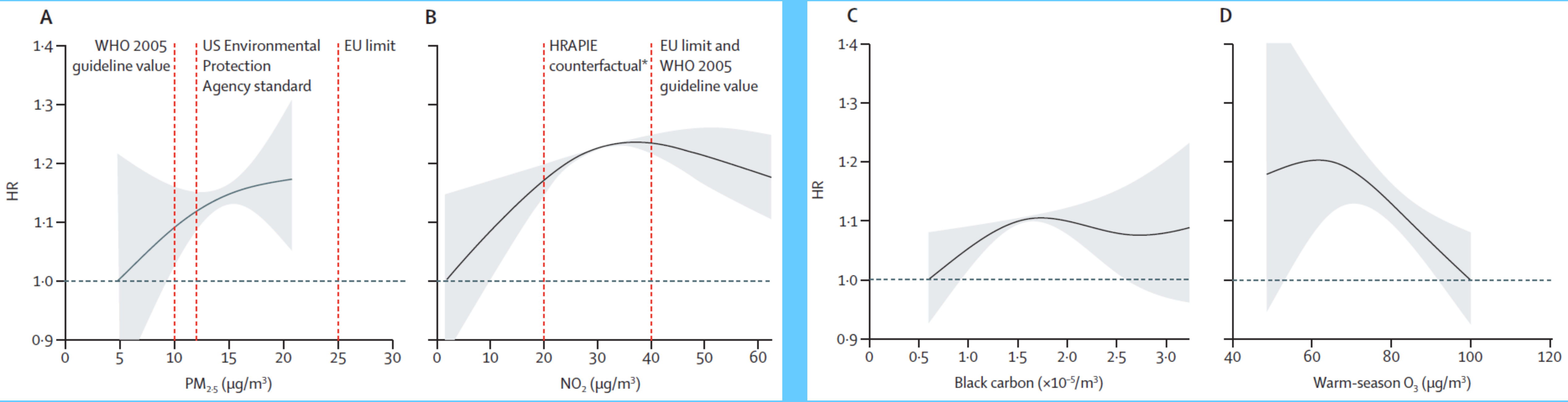
Note:
Although 41 European countries have been considered, based on the data availability, there was only possible to estimate the hospital admissions for 23.

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

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]

ELAPSE



Stafoggia, Lancet Planet Health 2022

New evidence: Economic and societal burden from air pollution is high

Joint Statement by Medical, Public Health and Scientific Societies

factors [8]. In terms of economic burden, the estimated global health-related external costs (i.e., those borne by society as a whole) were US$ 5 trillion in 2013 with an additional US$ 225 billion in lost labour productivity [9]. For the WHO European Region, the overall annual economic cost of health

impacts and mortality from air pollution, including estimates for morbidity costs, stood at US$ 1.575 trillion [10].

Costs from disease burden

Programmes that reduce air pollutant emissions provide enormous air quality and health benefits which increase over time. The estimated health benefits of improved air quality outweigh by far the implementation costs of air quality actions. For the US, it has been estimated that the benefits from decreased mortality, lower medical expenditures for air pollution-related diseases, and higher productivity of workers are

around 30 times greater than the costs of the Clean Air Act, resulting in net improvements of economic growth and population welfare [19]. In China, public health benefits were

Beneficial cost-benefit-ratio for clean air policies

ITALIAN EPIDEMIOLOGICAL SURVEYS (1980-2011)

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 vs rural factor

Epidemiological Studies of Po Delta and Pisa

General Population: Urban vs sub-urban factor

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	
	Zona rurale	Zona urbana	

*By χ^2 test.

[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

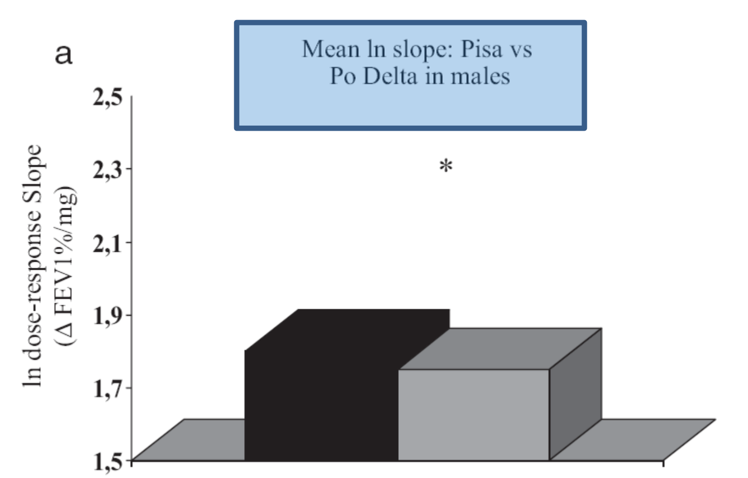
Table 3 *Multiple regression logistic analysis of the presence of serum anti-BPDE-DNA antibodies with questionnaire variables*

	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

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



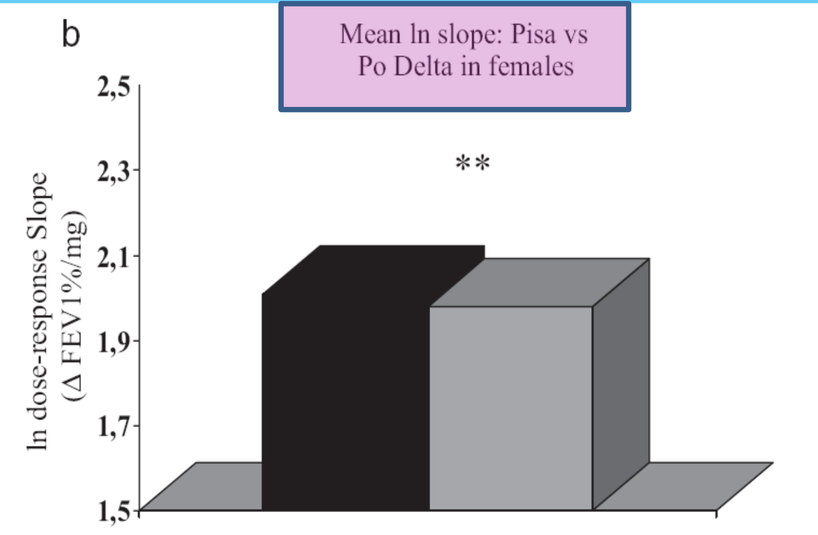


FIGURE 1. *Top*, *a*: *$p < 0.05$ with ANOVA. *Bottom*, *b*: **$p < 0.01$ with ANOVA. Gray columns indicate Po Delta; black columns indicate Pisa.

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

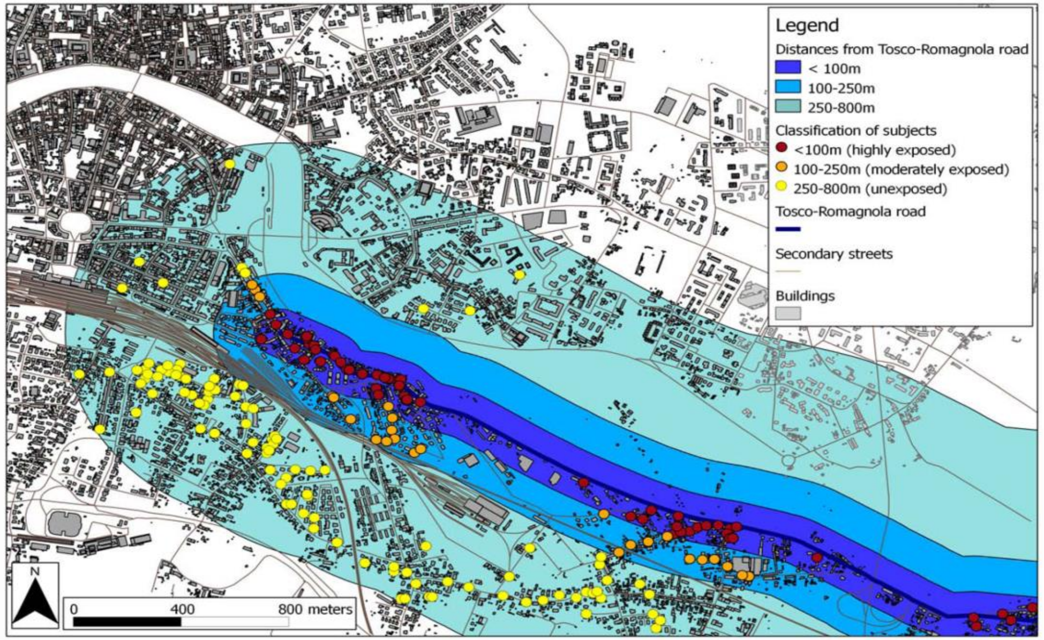


Figure 2 Classification of subjects based on the distance of each home from the main road. Zoomed map representing the classification of subjects according to the distance of each home from the main road. Highly exposed subjects are those living in the buffer area 0-100 m from the road, moderately exposed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

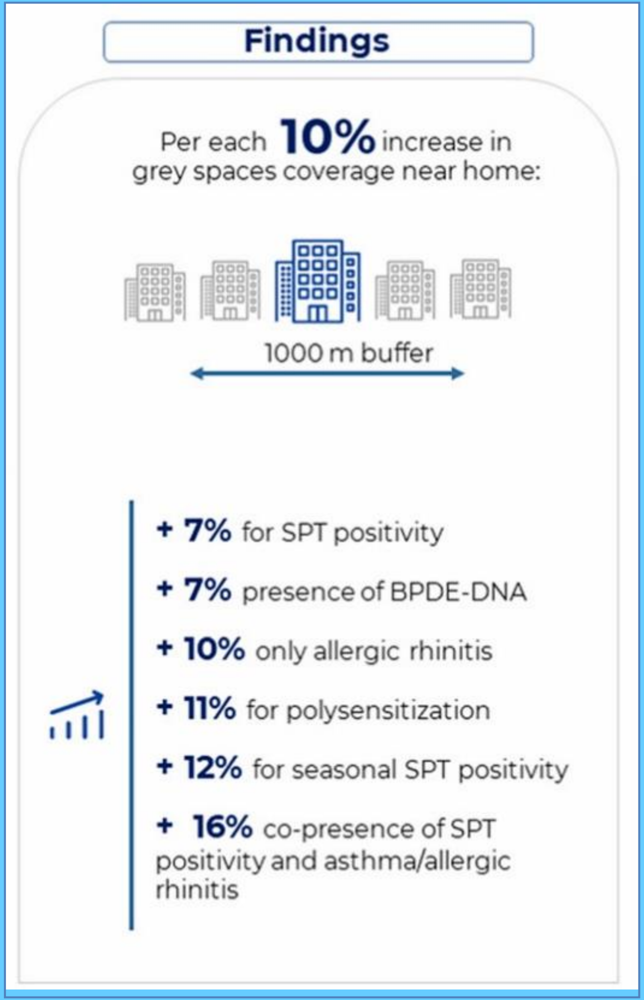
> Environ Res. 2022 Apr 15;206:112428. doi: 10.1016/j.envres.2021.112428. Epub 2021 Nov 24.

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

Coordinator:
Giovanni Viegi

June 29, 2017- December 28, 2019

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.

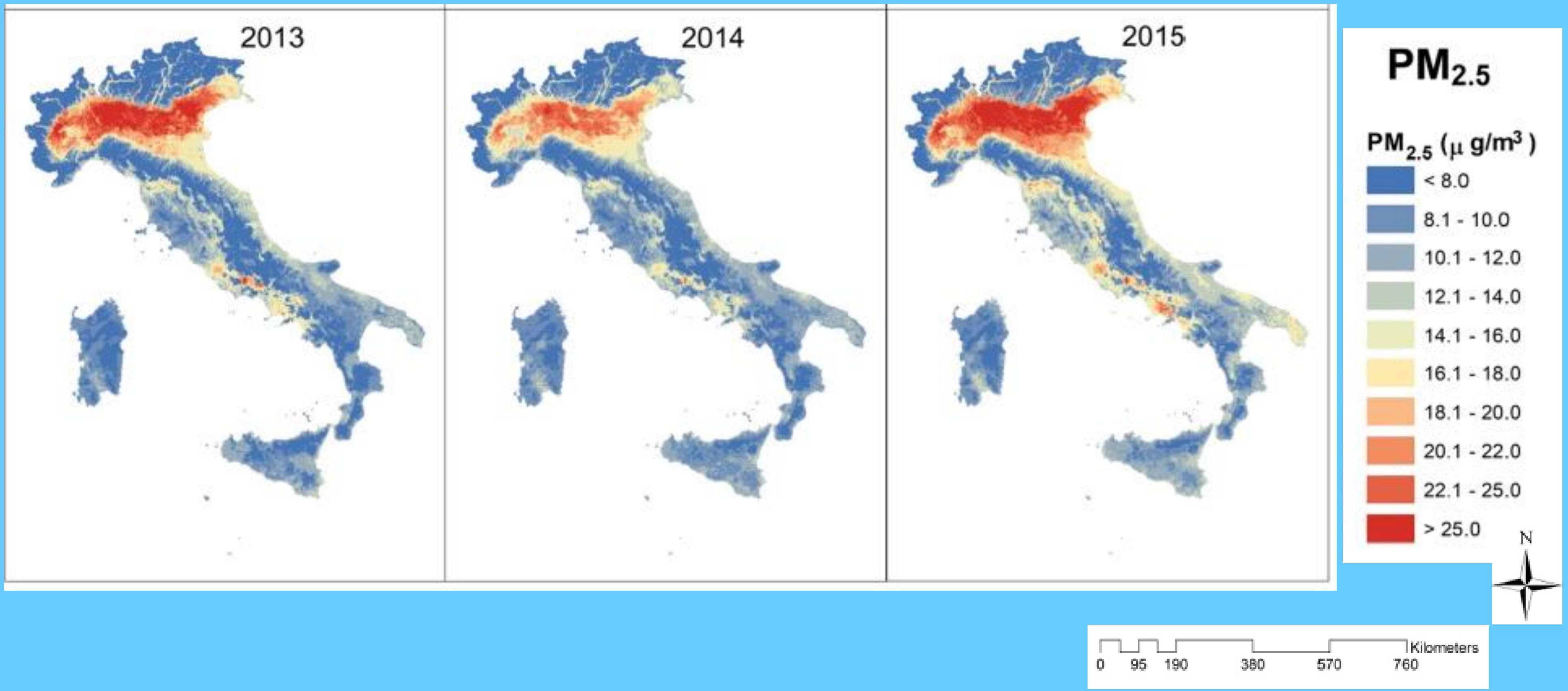


Fig. 2. Predicted PM_{10} (top) and $PM_{2.5}$ (bottom) concentrations from stage 4 model: annual means, 2013–2015.

Stafoggia et al, Environ Int 2019

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 †

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

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

2022 Feb 10;807(Pt 3):151034

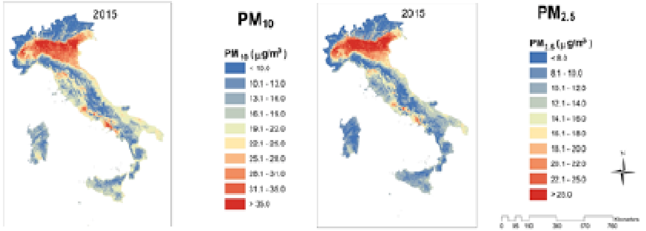
A nationwide study of air pollution from particulate matter and daily hospitalizations for respiratory diseases in Italy

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 [a]

Graphical abstract

A nationwide study of air pollution and daily hospitalizations for respiratory diseases in Italy

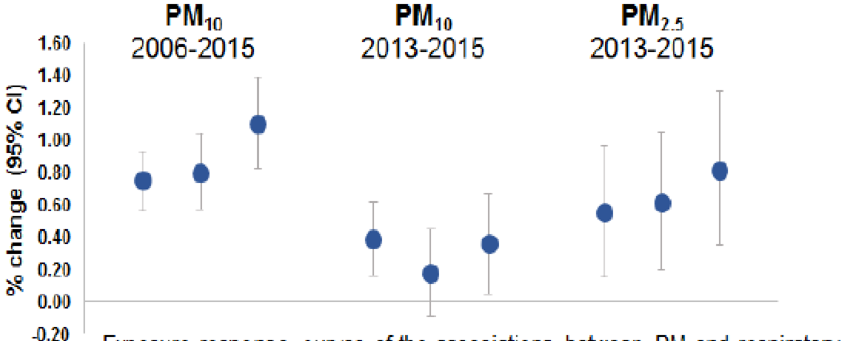
- Machine-learning approach to estimate PM exposure
- National health data database
- Sensitivity analyses (subgroup outcomes, effect modification, exposure-response curves)



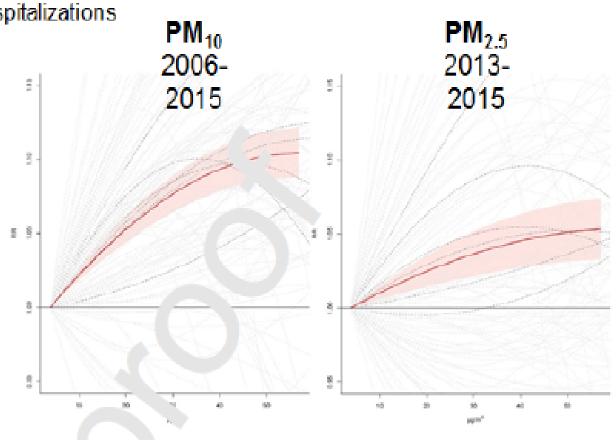
Annual concentrations of PM10 and PM2.5 in Italy

Conclusions:
In this study we provided evidence of harmful effect of PM_{10} and $PM_{2.5}$ on respiratory hospitalizations in Italy during 2006-2015 and we reported a positive association for a subgroup of respiratory outcomes such as asthma, COPD and LRTI. Low-level effects were detected.

Association with total respiratory hospitalizations



Exposure-response curves of the associations between PM and respiratory hospitalizations



Abstract

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.

Relationship of long-term air pollution exposure with asthma and rhinitis in Italy: an innovative multipollutant approach

Environmental Research 224 (2023) 115455

Sara Maio[1], Salvatore Fasola[2], Alessandro Marcon[3], Anna Angino[1], Sandra Baldacci[1], Maria Beatrice Bilò[4], Roberto Bono[5], Stefania La Grutta[2], Pierpaolo Marchetti[3], Giuseppe Sarno[1], Giulia Squillacioti[5], Ilaria Stanisci[1], Pietro Pirina[6], Sofia Tagliaferro[1], Giuseppe Verlato[3], Simona Villani[7], Claudio Gariazzo[8], Massimo Stafoggia[9], Giovanni Viegi[1], on behalf of the BIGEPI group*

Figure 1 Geographical distribution of the 6 cities

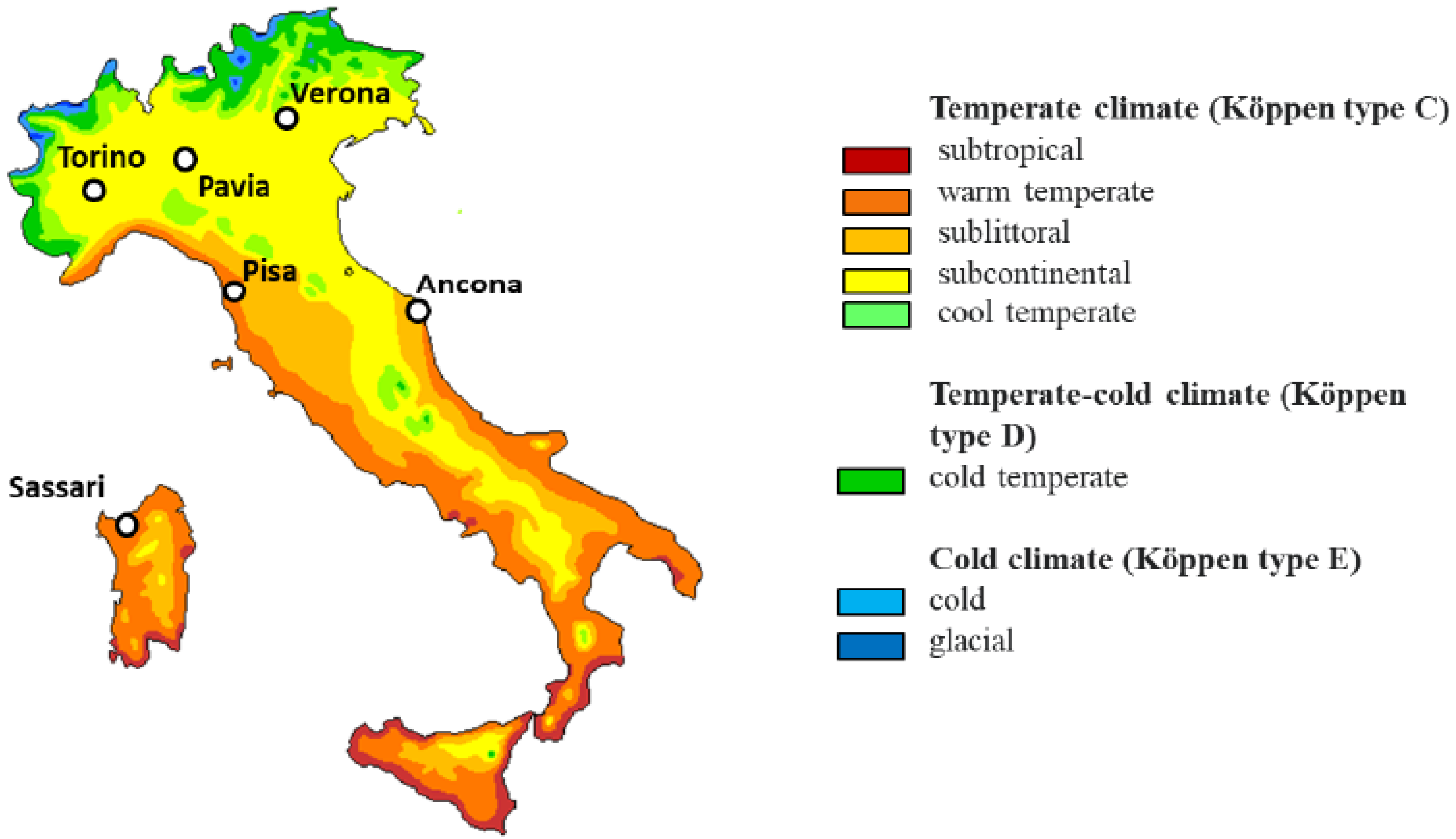


Fig. 4. Results of single-pollutant and multipollutant logistic regression models (OR and 95% CI for 10 μg/m3 increases): asthma.

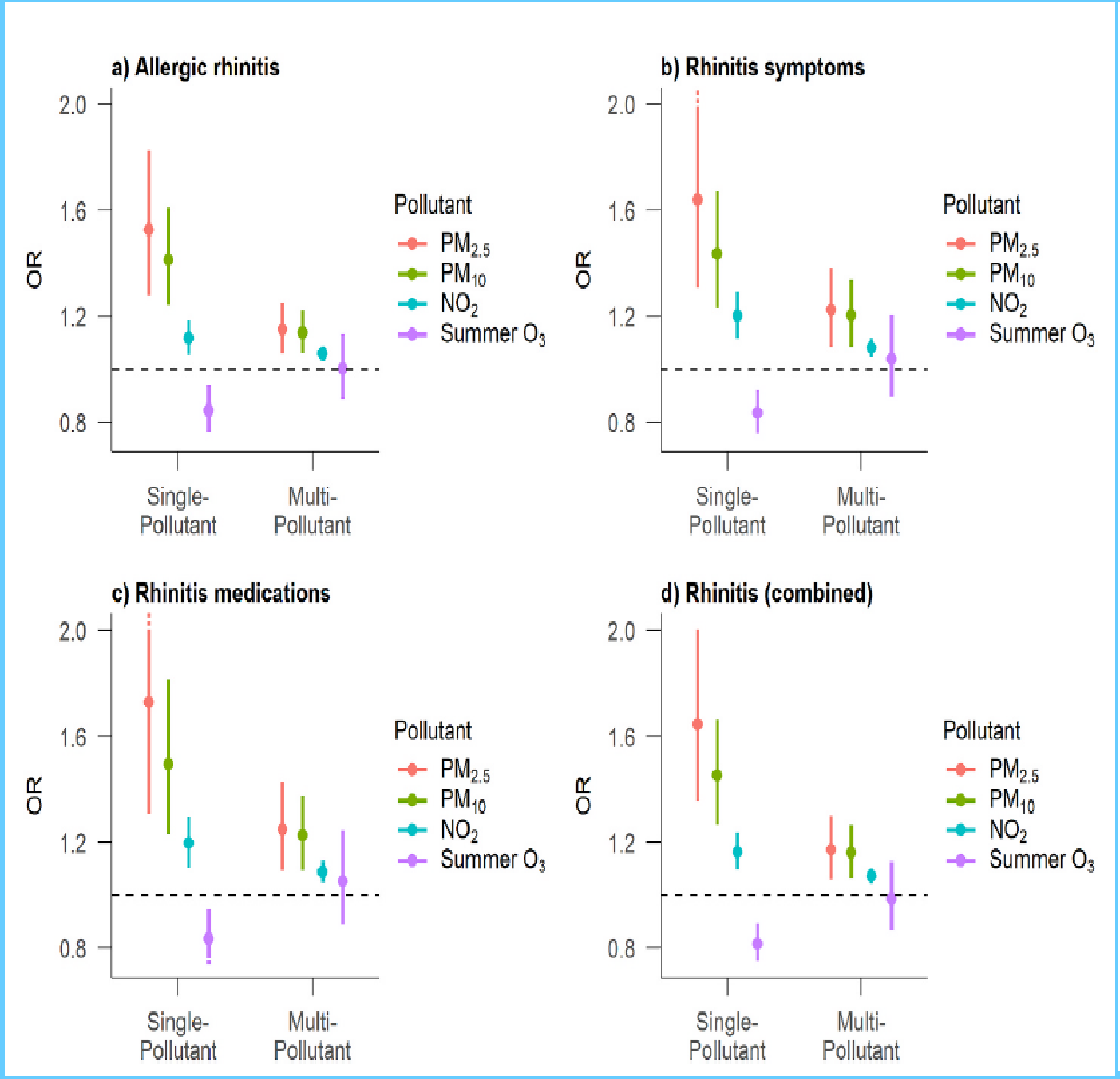
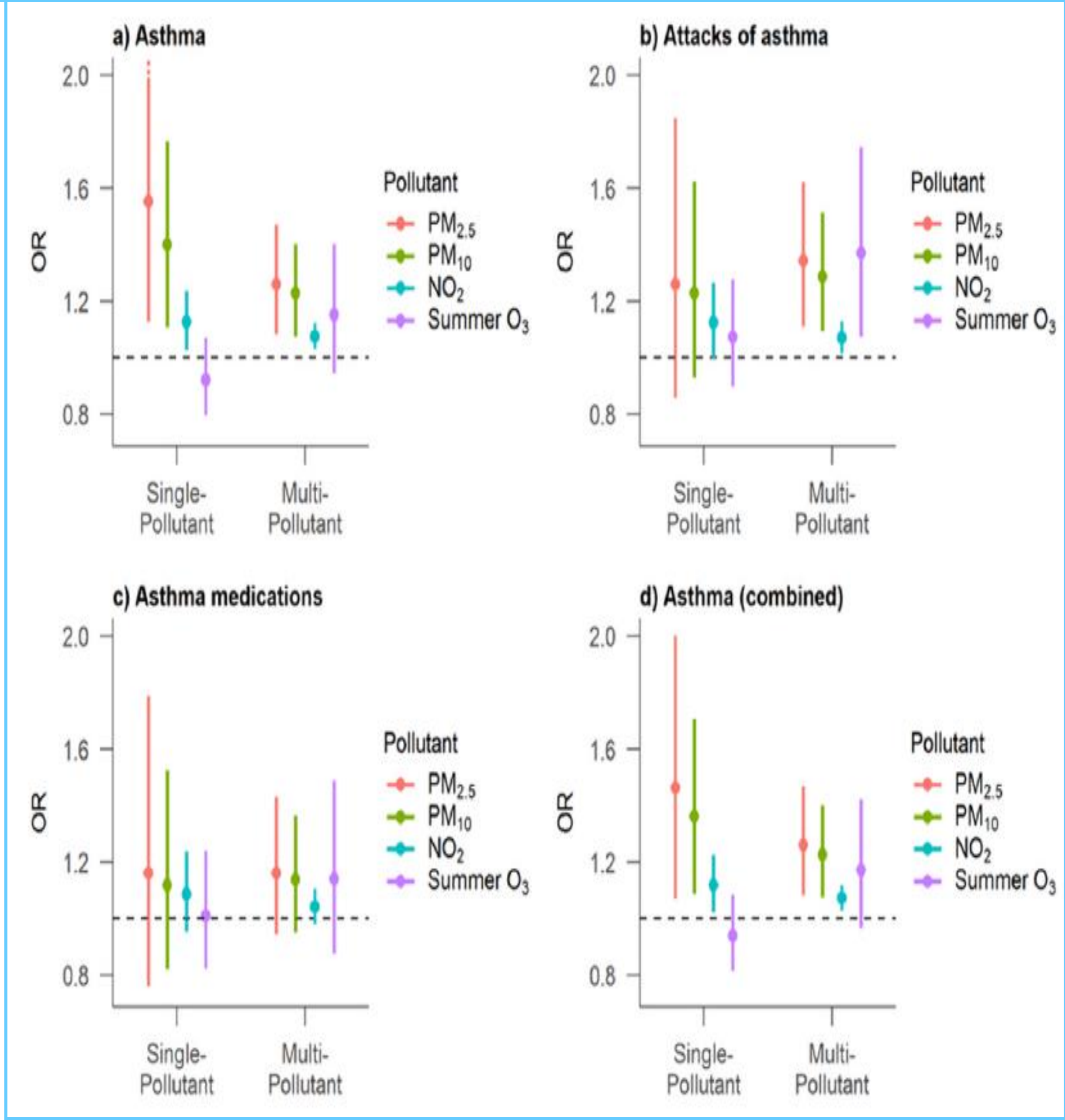


Fig. 3. Results of single-pollutant and multipollutant logistic regression models (OR and 95% CI for 10 μg/m^3 increases): rhinitis.



Maio, Environ Res 2023

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].

1)Direzione Generale della Prevenzione Sanitaria, Ministero della Salute, 2) Società Italiana Malattie Respiratorie Infantili (SIMRI), 3) Società Italiana di Allergologia, Asma e Immunologia Clinica (SIAAIC), 4) Associazione Allergologi Immunologi Italiani Territoriali e Ospedalieri (AAIITO), 5)Fondazione Mondo Respiro, Onlus, 6)Associazione Italiana Pneumologi Ospedalieri (AIPO), 7)Associazione Italiana Pazienti BPCO, Onlus, 8) Associazione Laziale Asma e Malattie Allergiche (ALAMA), 9) FederAsma e Allergie Onlus - Federazione Italiana Pazienti,10) Società Italiana di Pneumologia (SIP), 11) Società Italiana di Pneumologia - Italian Respiratory Society (SIP-IRS), 12)Associazione Italiana di Aerobiologia (AIA), 13) Società Italiana di Allergologia e Immunologia Pediatrica (SIAIP), 14) Consiglio Nazionale delle Ricerche (CNR),

Hanno inoltre collaborato alla stesura del documento:
Fabio Romeo, Direzione Generale per i Rifiuti e l'Inquinamento, Ministero dell'Ambiente e della Tutela del Territorio e del Mare.
Francesco Versaci, Ospedale Santa Maria Goretti, UOC UTIC emodinamica e cardiologia DEA, Latina.
Sara Bozzetto, Valeria Caldarelli, Antonino Francesco Capizzi, Maria Elisa Di Cicco, Giuliana Ferrante, Michele Ghezzi, in qualità di Junior Member SIMRI (JMs).

GARD Italy UN MONDO DOVE RESPIRARE LIBERAMENTE

NUOVE EVIDENZE A SUPPORTO DEL DOCUMENTO "INQUINAMENTO ATMOSFERICO E CAMBIAMENTI CLIMATICI Elementi per una strategia nazionale di prevenzione" Aggiornamento 2023

SOMMARIO

PREMESSA 4
INTRODUZIONE 5
1. INQUINAMENTO ATMOSFERICO ESTERNO 6
2. INQUINAMENTO ATMOSFERICO INDOOR 13
“Carico” di malattia (*Burden of Disease*) 13
Gli effetti sulla salute dell’inquinamento indoor 15
Gruppi a rischio 17
Cause dell’inquinamento Indoor 18
Cottura dei cibi e riscaldamento 20
Riscaldamento e cottura dei cibi in Europa 20
1. Inquinamento interno dovuto alla cottura 20
2. Tipo di cibo, modo e luogo in cui viene preparato 21
3. Inquinamento interno dovuto al riscaldamento 21
4. Altre combustioni da attività domestiche 21
5. Inquinamento indoor originato dall'aria esterna 22
6. Radon 22
3. VARIAZIONI CLIMATICHE E LORO INTERFERENZE SULLE PATOLOGIE RESPIRATORIE. 23
Variazioni climatiche, come si determinano? 23
La peculiarità dei pollini allergenici e dell’allergia da pollini 24
Effetti delle variazioni climatiche sull’inquinamento chimico atmosferico in Corso di CC 25
Climate change e suo impatto sulle malattie infettive respiratorie 26

4. STRATEGIE DI PREVENZIONE: MITIGAZIONE E ADATTAMENTO 28

Obiettivo Strategico 1: Promuovere un approccio integrato per affrontare le problematiche legate all'inquinamento atmosferico ed ai CC 28

Obiettivo Strategico 2: Integrare le politiche per ridurre le emissioni in atmosfera e per migliorare la qualità dell'aria con le altre politiche e conferirgli priorità................................. …… .31

Obiettivo strategico 3: Ridurre le emissioni di gas serra e raggiungere i co-benefici di salute previsti dall'applicazione dell'Accordo di Parigi del 2015 32

Obiettivo strategico 4: Garantire il rispetto degli standard fissati dalle direttive dell'Unione Europea in un processo di miglioramento continuo della qualità dell'aria 33

Obiettivo strategico 5: Potenziare il trasporto attivo, ampliare le zone di aria pulita nelle aree urbane nell'ambito di programmi di riqualificazione urbana e di sviluppo sostenibile del territorio 38

Obiettivo strategico 6: Migliorare il monitoraggio ed estendere la valutazione ambientale e sanitaria dell'inquinamento atmosferico, in particolare nei luoghi frequentati dalle fasce di popolazioni più vulnerabili 40

Obiettivo strategico 7: Promuovere politiche energetiche “low carbon” ... 42

Obiettivo strategico 8: Promuovere specifiche misure e linee guida per migliorare la qualità dell’aria indoor (IAQ) ... 44

Obiettivo strategico 9: Sviluppare azioni di sistema, intersettoriali, che mettano al centro la promozione della salute e la prevenzione per creare ambienti di vita e di lavoro sani e sicuri ... 46

Obiettivo strategico 10: Promuovere la sostenibilità ambientale e l’adattamento del sistema sanitario in relazione ai cambiamenti climatici ed all’inquinamento atmosferico ... 48

ALLEGATO 1 ... **Errore. Il segnalibro non è definito.**

Qualità dell’aria atmosferica – Inquadramento normativo ... 50

Le nuove Linee Guida sulla qualità dell’aria dell’OMS 2021 ... 51

ALLEGATO 2 ... 53

Quadro politico, istituzionale di riferimento ... 53

Contesto europeo e internazionale - Politiche sanitarie ... 54

Contesto nazionale ... 60

BIBLIOGRAFIA ... 65

RINGRAZIAMENTI ... 75

PREMESSA

Nonostante il documento "INQUINAMENTO ATMOSFERICO E CAMBIAMENTI CLIMATICI" - Elementi per una strategia nazionale di prevenzione", consultabile sul Sito del Ministero della Salute[1] sia relativamente recente (2019), il Comitato Esecutivo dell'Alleanza Globale contro le Malattie Croniche Respiratorie (GARD-Italia) ha sentito l'esigenza di aggiornarlo.

Le motivazioni sono da rinvenire negli importanti avvenimenti successivi al 2019, quali: la pandemia da COVID-19; la pubblicazione delle nuove linee guida per la qualità dell'aria emanate dall'Organizzazione Mondiale della Sanità (WHO); la serie di pubblicazioni Lancet Countdown; i nuovi documenti dell'*Intergovernmental Panel on Climate Change* (IPCC); il programma *Next Generation* EU; il Piano Nazionale di Ripresa e Resilienza (PNRR); la realizzazione di nuove ricerche scientifiche e la pubblicazione dei loro risultati.

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

RINGRAZIAMENTI

Si ringraziano Sara Maio, Giuseppe Sarno, Ilaria Stanisci e Patrizia Silvi (Istituto di Fisiologia Clinica CNR, Pisa) per la preziosa assistenza editoriale.

Si ringrazia il Gruppo *Minds for one health* (M4OH), di cui sono stati ripresi alcuni documenti pubblicati nel 2022-23.

Si ringraziano anche i componenti del Comitato Esecutivo GARD-Italia per gli utili commenti.

Tabella 1. Confronto tra nuove Line guida OMS, precedenti Linee guida OMS e limiti normativi

		OMS – Linee guida per la qualità dell'aria 2005	OMS – Linee guida per la qualità dell'aria 2021	Direttive europee per la qualità dell'aria – Valori limite
$PM_{2,5}$	Annuali	10 $\mu g/m^3$	5 $\mu g/m^3$	25 $\mu g/m^3$
$PM_{2,5}$	Giornaliere (24 ore)	25 $\mu g/m^3$	15 $\mu g/m^3$	-
PM_{10}	Annuali	20 $\mu g/m^3$	15 $\mu g/m^3$	40 $\mu g/m^3$
PM_{10}	Giornaliere (24 ore)	50 $\mu g/m^3$	45 $\mu g/m^3$	50 $\mu g/m^3$
NO_2	Annuali	40 $\mu g/m^3$	10 $\mu g/m^3$	40 $\mu g/m^3$
NO_2	Giornaliere (24 ore)	-	25 $\mu g/m^3$	50 $\mu g/m^3$

Tabella 2. Morti premature attribuibili ad esposizione a $PM_{2,5}$, NO_2 e ozono in Italia, 2019

$PM_{2,5}$			NO_2		O_3	
Popolazione (1.000)	**Media annuale**	**Morti premature**	**Media annuale**	**Morti premature**	**SOMO35**	**Morti premature**
59.817	14,5	49.900	20	10.640	6.657	3.170

Tabella 3. Anni di vita persi (YLL) attribuibili ad esposizione a $PM_{2,5}$, NO_2 e ozono in Italia, 2019

Paese	**YLL**	**YLL/100.000 abitanti**	**YLL**	**YLL/100.000 abitanti**	**YLL**	**YLL/100.000 abitanti**
Italia	504.500	843	107.600	180	33.200	55

Tabella 4. Benefici teorici sulla salute, in termini di riduzione delle morti premature, che sarebbero stati ottenuti nel 2019 nei 27 paesi europei se fossero stati soddisfatti i differenti valori limiti europei e le linee guida OMS per il $PM_{2,5}$.

	Morti premature dovute al $PM_{2,5}$	Riduzione delle morti premature in base ai livelli del 2019	% riduzione delle morti premature in base ai livelli del 2019	% riduzione delle morti premature in base ai livelli del 2005
Concentrazioni nel 2019	306.700	-	-	33%
Valori limite europei 25 µg/m³	306.500	200	0%	33%
Valori limite indicativi europei 20 µg/m³	303.500	3.200	1%	33%
Target intermedio 3 del 2021 OMS 15 µg/m³	289.200	17.500	6%	37%
Target intermedio 4 del 2021 OMS (linee guida sulla qualità dell'aria OMS 2005) 10 µg/m³	241.400	65.300	21%	47%
Linee guida sulla qualità dell'aria OMS 2021 5 µg/m³	129.400	177.300	58%	72%

NB: Il target intermedio e le linee guida OMS sono stati estrapolati dall'aggiornamento delle linee guida pubblicate nel 2021.

Tabella 5. Benefici teorici sulla salute, in termini di riduzione delle morti premature, che sarebbero stati ottenuti nel 2019 se fossero stati soddisfatti i differenti valori limiti europei e le linee guida OMS per il $PM_{2,5}$, in Italia.

Livelli 2019	**Valore limite europeo 25 µg/m³**		**Valore indicativo europeo 20 µg/m³**		**Target intermedio 3 OMS 15 µg/m³**		**Target intermedio 4 OMS (linee guida sulla qualità dell'aria OMS 2005) 10 µg/m³**		**Linee guida sulla qualità dell'aria OMS 5 µg/m³**	
Morti premature	Morti premature	% riduzione dei livelli 2019	Morti premature	% riduzione dei livelli 2019	Morti premature	% riduzione dei livelli 2019	Morti premature	% riduzione dei livelli 2019	Morti premature	% riduzione dei livelli 2019
49.900	49.900	0	49.100	2	45.200	9	34.500	31	17.700	65

Figura 1. Numero di decessi per fattore di rischio, nel mondo 2019

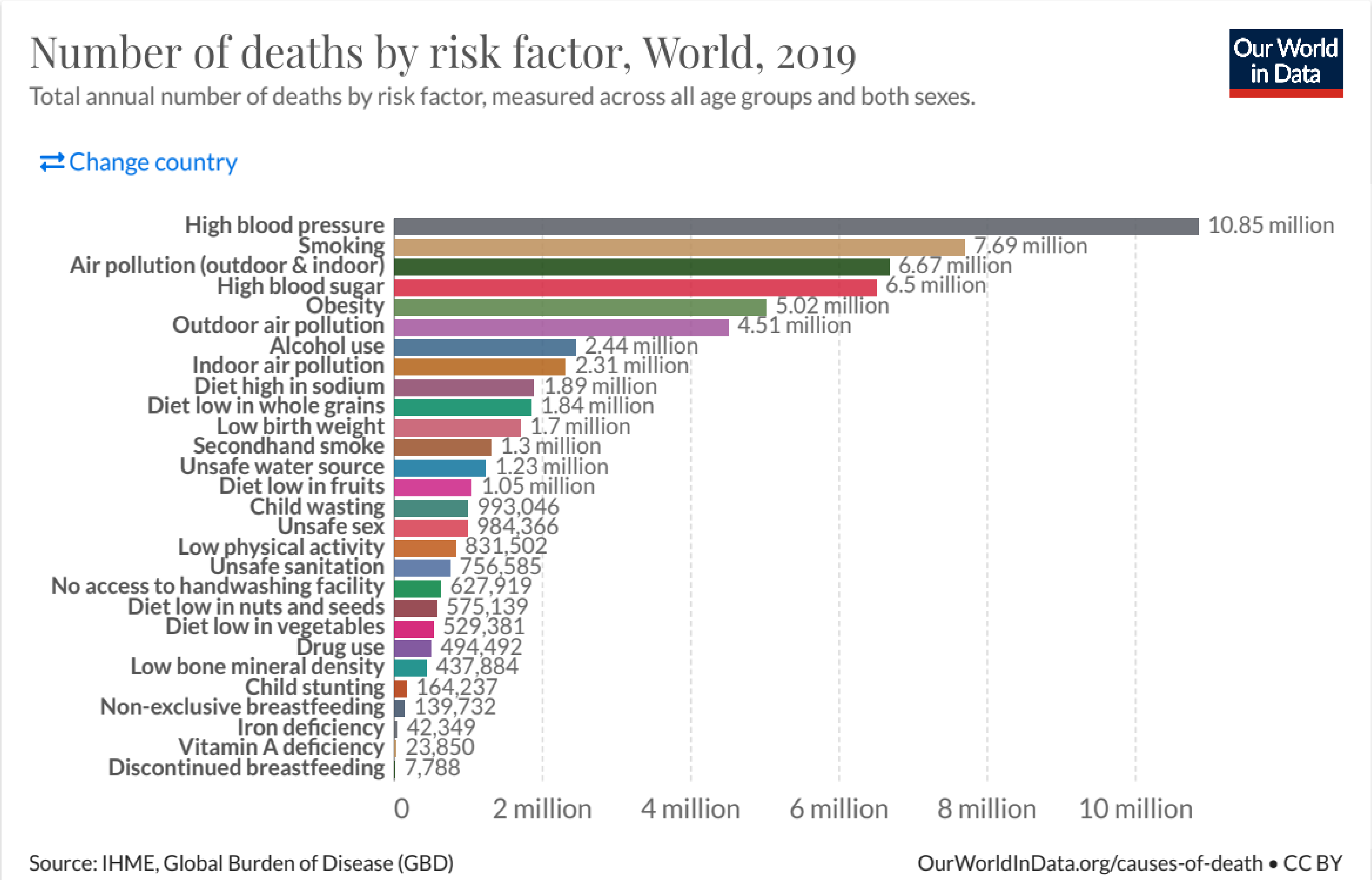


Figura 2. Numero di decessi per fattore di rischio, Italia, 2019

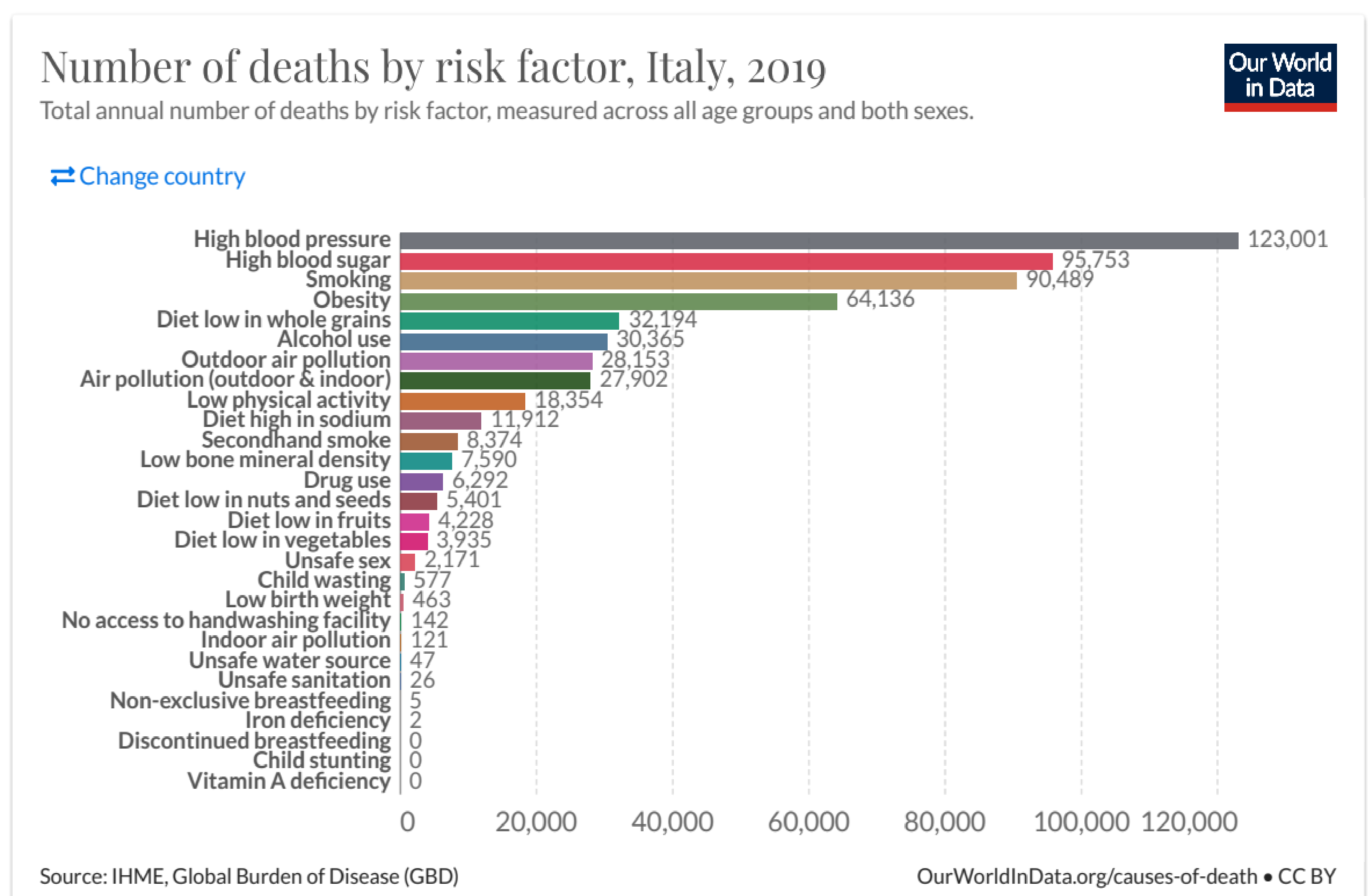


Figura 3. Tasso di mortalità per inquinamento atmosferico, Mondo, 1990- 2019

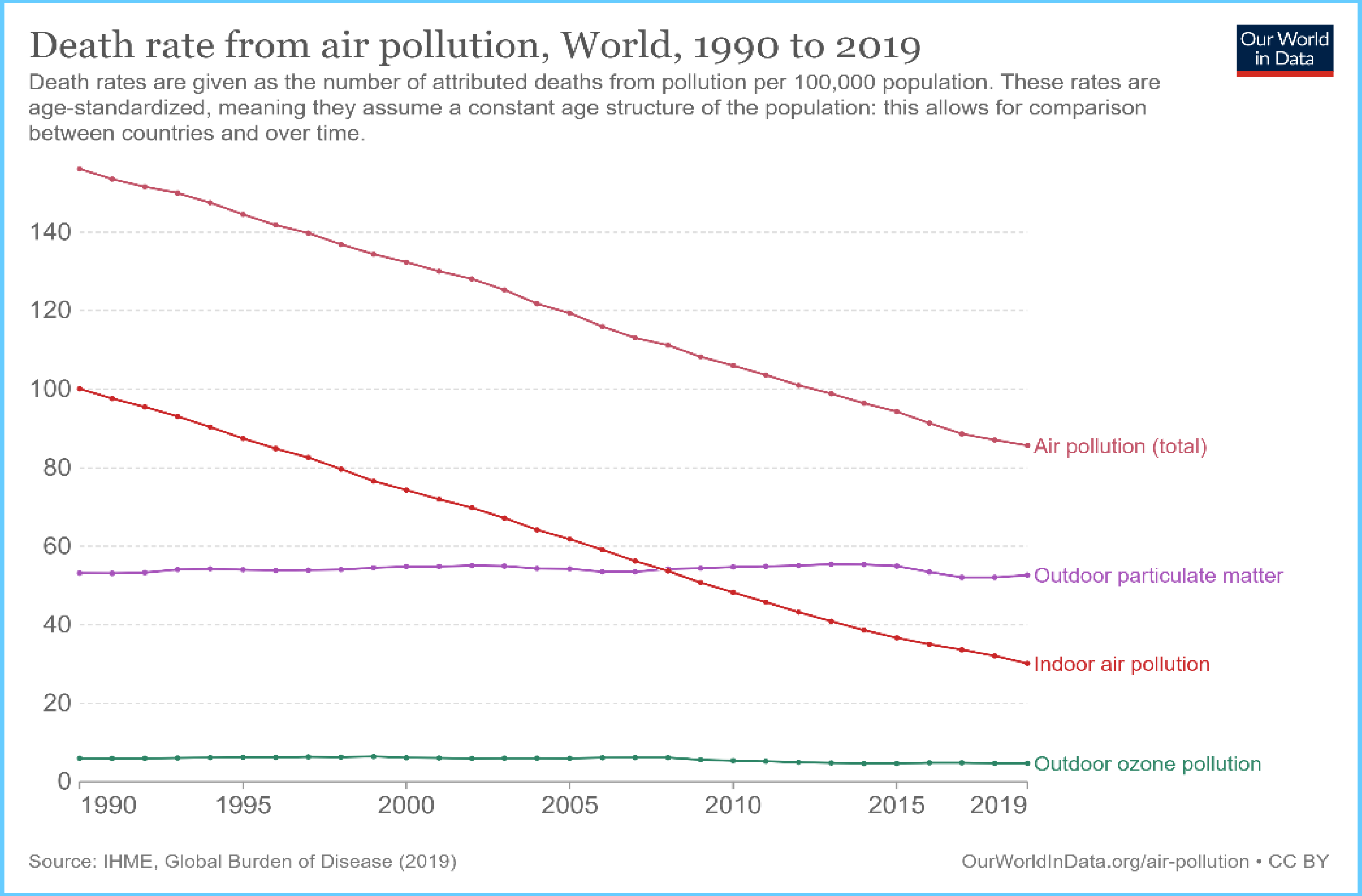
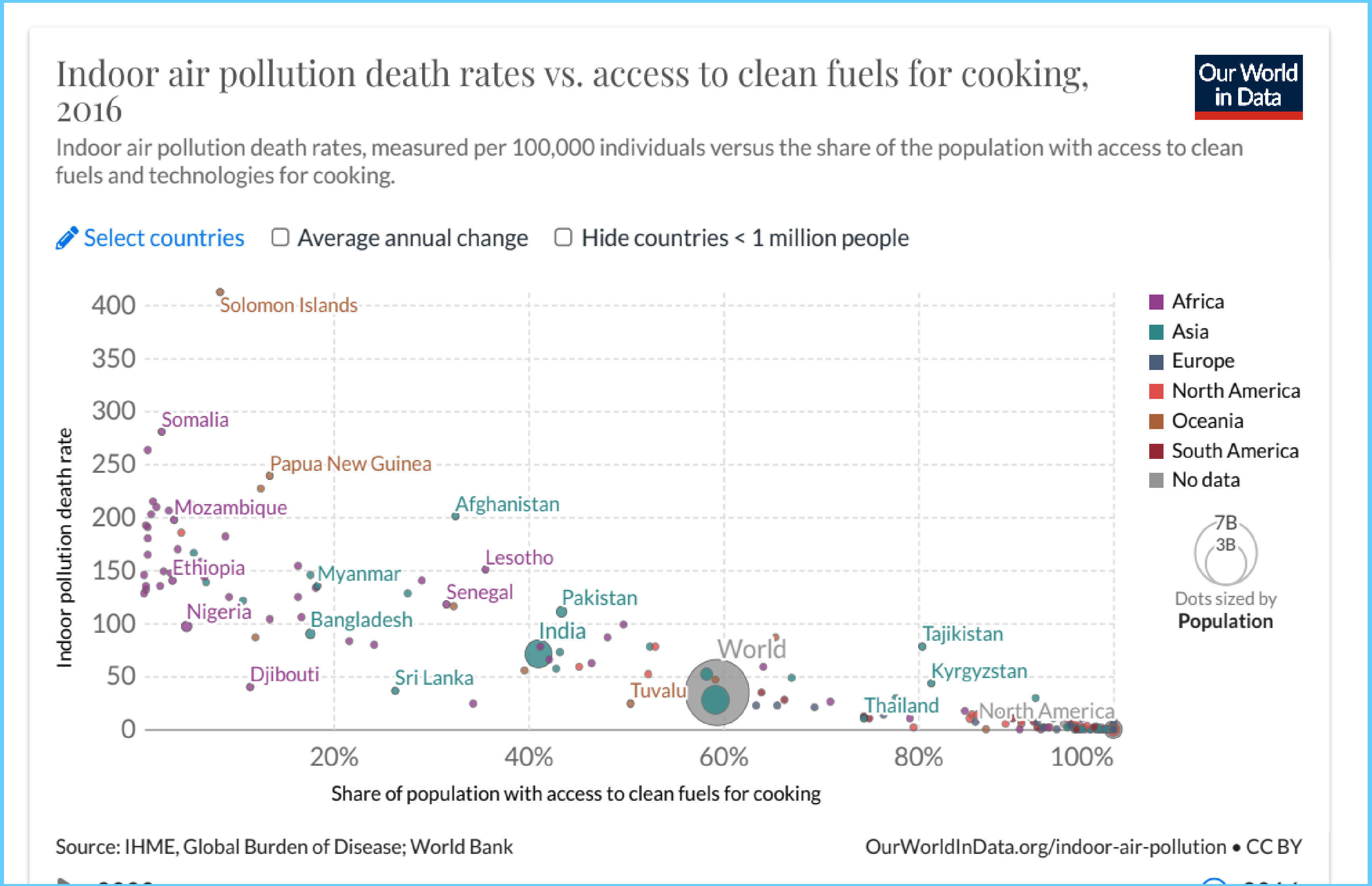


Tabella 6. Principali agenti indoor e potenziali fonti interne[45]

FONTI	INQUINANTI
Processi di combustione a gas o carbone per riscaldare e/o cucinare, camini e stufe a legna, gas di scarico veicoli	Prodotti di combustione (CO, NO_x, SO_2, particolato)
Materiali da costruzione e isolanti	Amianto, fibre vetrose artificiali, particolato, Radon; Agenti biologici (per presenza di umidità e/o polvere)
Materiali di rivestimento e moquette	Formaldeide, acrilati, COV e Agenti biologici (per presenza di umidità e/o polvere)
Arredi	Formaldeide, COV e Agenti biologici (per presenza di umidità e/o polvere)
Liquidi e prodotti per la pulizia	Alcoli, fenoli, COV
Fotocopiatrici	Ozono (O_3), polvere di toner, idrocarburi volatili (COV)
Fumo di sigaretta	Idrocarburi policiclici, COV, formaldeide, CO, particolato fine
Impianti di condizionamento	CO_2 e COV (per scarso numero di ricambi orari o eccesso di riciclo); Agenti biologici (per mancanza di pulizia / manutenzione)
Polvere	Agenti biologici (allergeni indoor: acari)
Individui	CO_2 e Agenti biologici (batteri, virus ecc.)
Animali	Allergeni indoor (peli, etc.)
Sorgenti naturali (lave, tufi, graniti, ecc.)	Radon

Figura 4. Tasso di mortalità per Inquinamento atmosferico indoor vs accesso a combustibile pulito per cucinare



Il raddoppio delle concentrazioni atmosferiche di CO_2(da 200 a700 ($\mu L\ L^{-1}$ induce l'incremento della produzione di polline allergenico di ambrosia (ragweed) del 61%

(Wayne P. Annals of Allergy, Asthma & Immunolog, 2002)

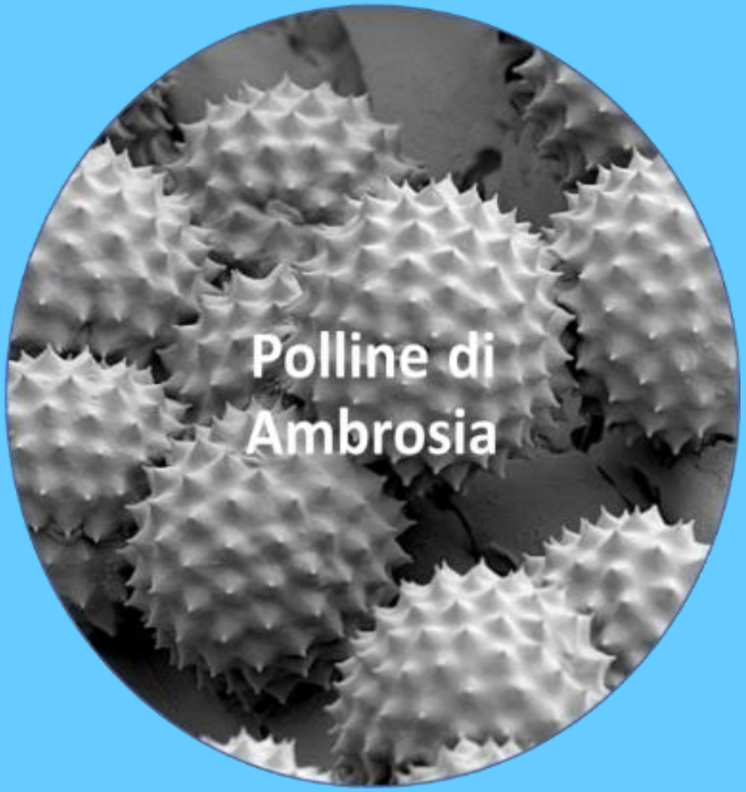


Tabella 7 ***Interventi per la prevenzione delle malattie respiratorie croniche (MRC), con particolare riguardo al fattore di rischio indoor***

LIVELLO INDIVIDUALE	Aumentare la consapevolezza sull'utilità dell'uso continuo di inalatori per massimizzarne i benefici.
	Evitare l'uso della biomassa per cucinare o riscaldare e l'esposizione al fumo di seconda mano (ETS).
LIVELLO COMUNITARIO	Cambiare le percezioni sulle MRC e de-stigmatizzarle attraverso interventi educativi.
	Aumentare la consapevolezza sull'importanza della famiglia nel fornire supporto fisico, economico e psicologico ai pazienti con MRC.
LIVELLO DEL SISTEMA SANITARIO	Aumentare la comunicazione con i pazienti sul decorso della malattia e sui fattori di rischio.
	Migliorare le interazioni con la comunità attraverso operatori sanitari in prima linea.
	Coinvolgere la comunità con mezzi e metodi culturalmente accettabili e disponibili a livello locale.
	Migliorare la disponibilità e l'accessibilità della spirometria nelle cure primarie.
	Laddove la spirometria non è disponibile, prendere in considerazione alternative come questionari e strumenti validati (es. PEF), in particolare nei Paesi a basso-medio reddito.
	Attuare linee guida operative di assistenza primaria e programmi di formazione per operatori sanitari clinici e operatori sanitari di comunità.
	Migliorare la disponibilità e dell'accessibilità dei farmaci.
	Investire in strategie per ridurre gli ostacoli a comportamenti sani dei pazienti con CRD.
	Attuare programmi potenziati per combustibili più puliti e apparecchi migliori.
LIVELLO POLITICO	Sviluppare una politica sanitaria specifica per le MRC con protocolli basati sull'evidenza, supportati dalla regolare disponibilità e accessibilità di attrezzature mediche e farmaci.
	Definire norme specifiche per la gestione della qualità dell'aria interna.
LIVELLO DELLE SOCIETA' SCIENTIFICHE	Aumentare la consapevolezza sul carico socio-sanitario dei pazienti con CRD e sui relativi fattori di rischio.
	Lavorare insieme per perseguire la visione GARD di "un mondo in cui tutte le persone respirano liberamente".

Tabella 8 Valori di riferimento OMS

Inquinante	Tempo	Interim target				Livelli AQG
		1	2	3	4	
$PM_{2,5}$ µg/m^3	Annuale	35	25	15	10	5
	24 h	75	50	37.5	25	15
PM_{10} µg/m^3	Annuale	70	50	30	20	15
	24 h	150	100	75	50	45
O_3 µg/m^3	Picco stagionale	100	70			60
	8 h	160	120			100
NO_2 µg/m^3	Annuale	40	30	20		10
	24 h	120	50			25
SO_2 µg/m^3	24 h	125	50			40
CO mg/m^3	24 h	7				4

EDITORIAL

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

G. Viegi[a,b,*], L. Taborda-Barata[c,d,e]
[a] CNR Institute for Biomedical Research and Innovation (IRIB), Via U. La Malfa, 153 - 90146 Palermo, Italy
[b] CNR Institute of Clinical Physiology (IFC), Via Trieste 41 - 56126 Pisa, Italy
[c] NuESA-Health and Environment Study Unit, Faculty of Health Sciences, University of Beira Interior, Avenida Infante D. Henrique, 6200-506 Covilhã, Portugal
[d] UBIAir-Clinical & Experimental Lung Centre, UBIMedical, University of Beira Interior, EM506, 6200-000 Covilhã, Portugal
[e] CICS-Health Sciences Research Centre, University of Beira Interior, Avenida Infante D. Henrique, 6200-506 Covilhã, Portugal

Pulmonology. 2022 Jul-Aug;28(4):243-244

ARTICLE IN PRESS
JID: PULMOE [mSP6P;February 23, 2022;21:10]
Pulmonology 000 (xxxx) 1—13
PULMONOLOGY
www.journalpulmonology.org

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,*]

Pulmonology. 2022 Jul-Aug;28(4):284-296

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.

INT J TUBERC LUNG DIS 27(1):7–12

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

“Grazie per l’invito e l’attenzione”.

Giovanni Viegi

www.ifc.cnr

www.ersnet.org

Ex