Air pollution and health - The importance of air monitoring and burden of disease for attaining the SDGs

Carla Martins

NOVA National School of Public Health, NOVA University Lisbon, Lisbon, Portugal
NOVA National School of Public Health, Comprehensive Health Research Center, CHRC, Universidade NOVA de Lisboa, Portugal

Air pollution and health

"Pollution— i.e., unwanted waste of human origin released to air, land, water, and the ocean without regard for cost or consequence—is an existential threat to human health and planetary health and jeopardizes the sustainability of modern societies."

"Air pollution is entwined with climate change because the emissions driving both development problems come largely from the same sources (e.g., fossil fuel or biofuel burning)."

Review

Pollution and health: a progress update

Richard Fuller, Philip J Landrigan, Kalpana Balakrishnan, Glynda Bathan, Stephan Bose-O'Reilly, Michael Brauer, Jack Caravanos, Tom Chiles, Aaron Cohen, Lilian Corra, Maureen Cropper, Greg Ferraro, Jill Hanna, David Hanrahan, Howard Hu, David Hunter, Gloria Janata, Rachael Kupka, Bruce Lanphear, Maureen Lichtveld, Keith Martin, Adetoun Mustapha, Ernesto Sanchez-Triana, Karti Sandilya, Laura Schaefli, Joseph Shaw, Jessica Seddon, William Suk, Martha María Téllez-Rojo, Chonghuai Yan

The *Lancet* Commission on pollution and health reported that pollution was responsible for 9 million premature deaths

Fuller *et al.* (2022)
Lancet Planet Health

Air pollution and health

Air quality in Europe — 2020 report

In **2019**, air pollution continued to drive a **significant burden of premature death and disease** in the **27 EU Member States**: 307,000 premature deaths were attributed to chronic exposure to fine particulate matter; 40,400 premature deaths were attributed to chronic nitrogen dioxide exposure; 16,800 premature deaths were attributed to acute ozone exposure.

Compared to 2005, in **2019 premature deaths attributed to exposure to fine particulate matter decreased by 33% in the EU-27**. If this rate of reducing premature deaths is maintained going forward, then the EU is expected to reach the Zero Pollution Action Plan target.

Had the new WHO air quality guideline for PM$_{2.5}$ of 5 µg/m^3 been attained across the EU-27 in 2019, then this would have delivered a **reduction in premature deaths of at least 72% compared with 2005** levels.

https://www.eea.europa.eu/
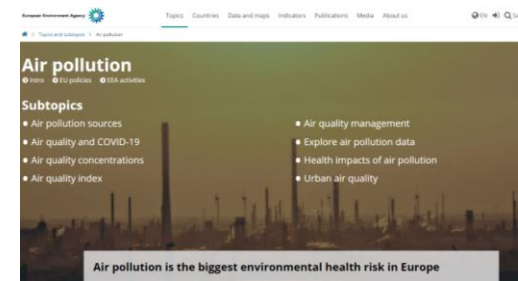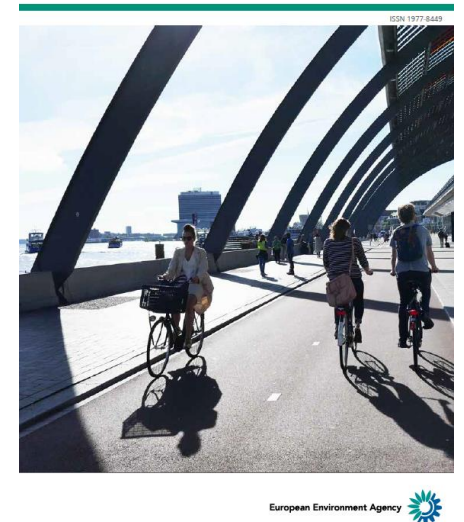
Air pollution and health

- Air pollution also has **considerable economic impacts** reflected in **premature deaths**, **increased medical costs** and **reduced productivity** through working days lost.

- The **monetization** is important to guarantee an adequate consideration in policy
  - calculation of healthcare-related savings
  - productivity losses
    - highlight the **economic burden** of air pollution
    - estimate the **economic value of policies** that address pollution
    - **economic cost of inaction**

SDGs and One Health

The importance of air pollution as a cause of disease is well reflected in the Sustainable Development Goals, mainly in:

But indirectly in all SDGs

1 NO POVERTY

3 GOOD HEALTH AND WELL-BEING

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

13 CLIMATE ACTION

15 LIFE ON LAND

SUSTAINABLE DEVELOPMENT GOALS

"The Sustainable Development Goals in themselves can be understood as embodying a One Health strategy aimed at healthy people living on a perpetually habitable planet."

The Lancet One Health Commission, 2020

SDGs and One Health

Heart disease, stroke, chronic obstructive pulmonary disease, cancer and pneumonia
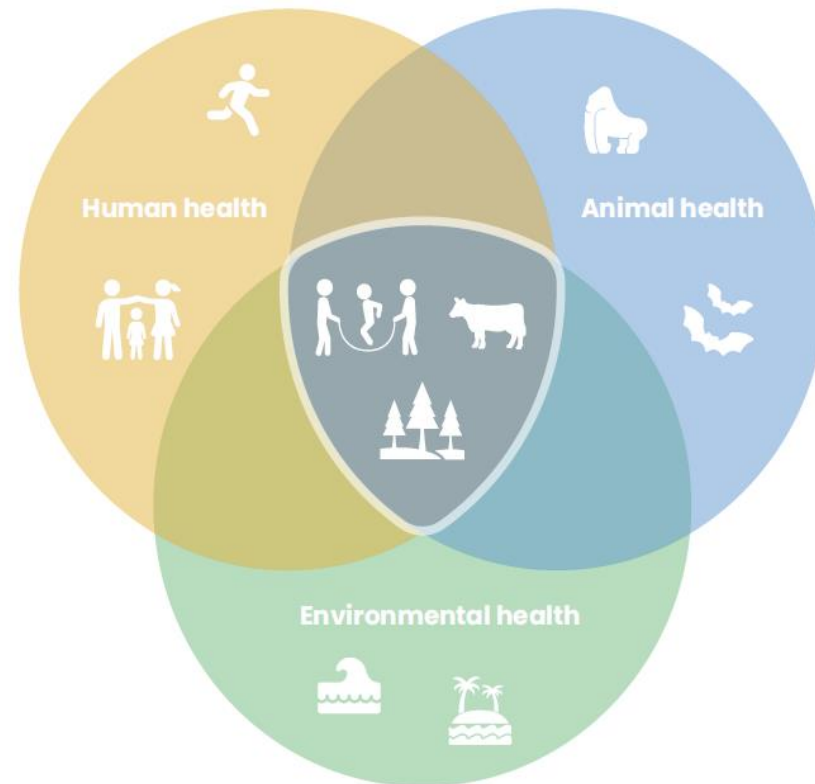
Human health

Animal health

Environmental health

Fluorides accumulated in crops fed to animals cause bone and teeth damage that may even harm the animal's ability to eat. Other pollutants injurious to animals include carbon monoxide, hydrogen sulfide, bromine, iodine and mercury vapour.

Air pollutants penetrate plants; it causes oxidative stress, disrupts photosynthesis and can cause massive plant death.

Reduction of air pollution

Heart disease, stroke, chronic obstructive pulmonary disease, cancer and pneumonia

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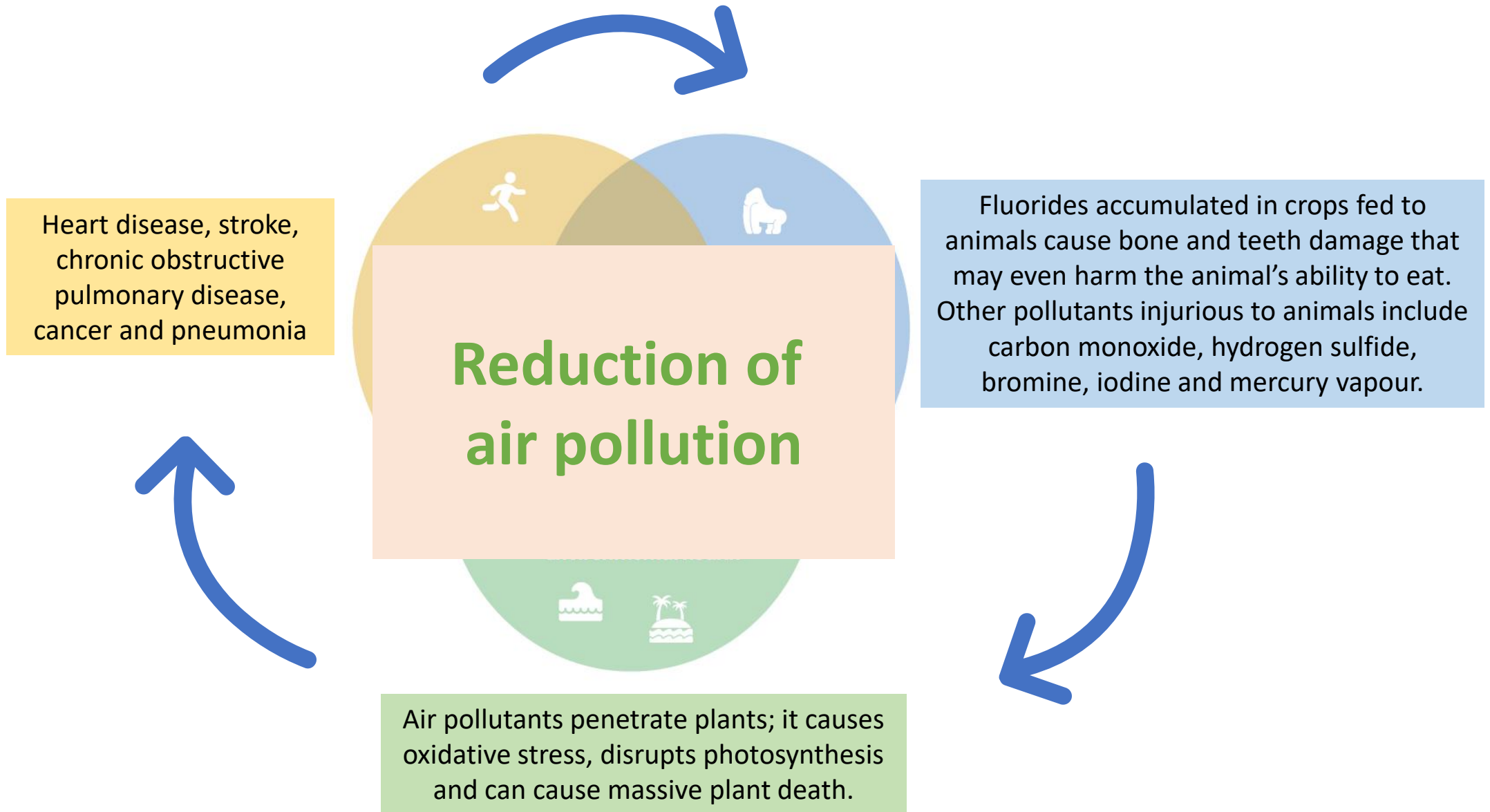
Burden of Disease

- The 1st Global Burden of Disease (GBD) Study was launched by the World Bank and the World Health Organization in 1991

- Consistent and comparative description of diseases, injuries, and respective risk factors

- Important **input to health decision-making** and **planning processes**

- Disability-adjusted life years (DALYs) - health gap summary measures (health gap quantifies the difference between the actual health of a population and some stated norm or goal for population health)

  - Morbidity + mortality

  - Disease occurrence + disease severity

- Environmental Burden of Disease (EBD) – **emphasizes the link between health and environment, focusing on risk factors**

  - Population Attributable Fraction is a key component

Prüss-Üstün & Corvalán 2007; Murray et al. 2013; Lippe et al. 2020

PMCardImpact

- **PMCardImpact**: the health and economic impact of $PM_{2.5}$-related cardiovascular diseases in Portugal

- National funded project (FCT – EXPL/SAU-PUB/0944/2017)

- 18 months

- Aims:

  - To assess the exposure of Portuguese population to $PM_{2.5}$

  - To estimate the burden of disease and economic impact of $PM_{2.5}$-related CVD in Portugal

  - To identify the areas for cost-effective public health interventions

- **Particle matter 2.5 µm ↔ Cardiovascular diseases**

PMCardImpact

Burden of PM$_{2.5}$-related CVD in Portugal

- **Exposure → Risk**
  PM$_{2.5}$ levels - national and European air monitoring platforms
  Software AirQ+ - WHO Europe

- **Burden of disease**
  Outline of disease models
  Disease burden attributable to exposure to PM$_{2.5}$
  Metric - Disability-Adjusted Life Years (**DALYs**).

- **Economic evaluation**
  Group of experts (general practitioners and cardiologists)
  Elicitation - fixed interval method
  CVD individual direct and indirect costs for Portugal

Four scenarios of exposure :

- Current scenario

- Worst-case scenario – maximum PM$_{2.5}$ level detected

- WHO Air Quality Guidelines 2006 – PM$_{2.5}$ = 10 µg/m^3

- WHO Air Quality Guidelines 2021 – PM$_{2.5}$ = 5 µg/m^3
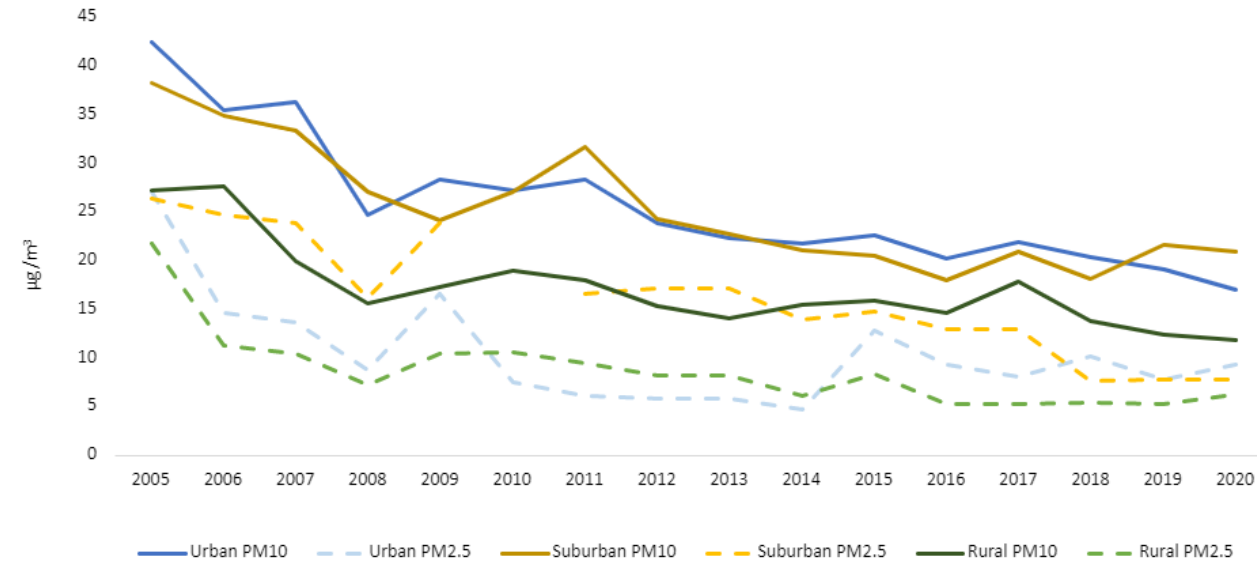
Figure: Atmospheric levels (in µg/m3) of particulate matter (PM$_{10}$ and PM$_{2.5}$), in urban, suburban and rural regions in Portugal, in the period 2005–2020. Data represent year averaged values collected from stations of the Air Quality Network of the Portuguese Environment Agency (QualAr).
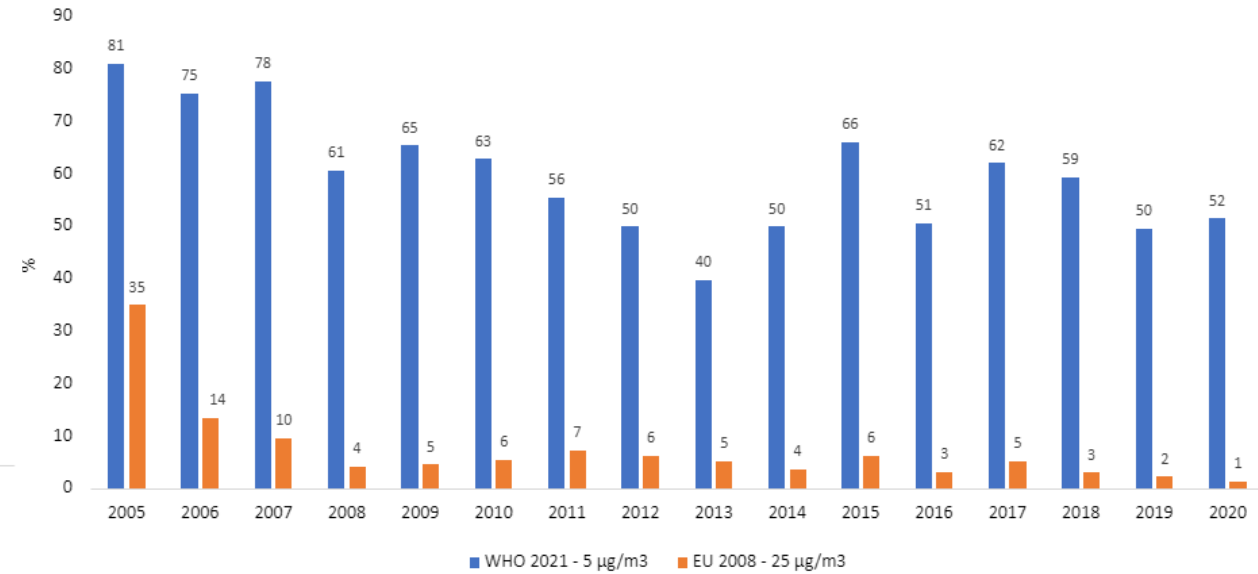
Figure: Percentage of hourly exceedance of air quality guidelines (WHO, 2021 and EU Air Quality Directive, 2008) of particulate matter (PM$_{2.5}$), of all monitoring stations, in the period 2005–2020. Data was collected from stations of the Air Quality Network of the Portuguese Environment Agency (QualAr).

PMCardImpact

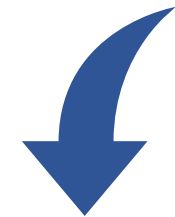Data from **epidemiologic** and **economic** domains will be analyzed and **integrated**.

DATA

KNOWLEDGE

PMCardImpact will provide to policy makers the supporting information to act, including knowledge on **air pollution trends**, **related health effects** and **estimated costs**, **to implement reducing air pollution policies**.

ACTION

Adoption of WHO Air Quality Guidelines in European Union

Take-home messages

- **Monitoring and surveillance** systems are the starting point, generating evidance-based data for further assessments

- **Burden of disease,** expressed in DALYs, as a comparative quantification of morbidity and mortality data, is used by decision makers to evaluate and monitor public health, and also prioritize the allocation of resources

- In a **One Health** perspective, the reduction of air pollution will have benefits for human, animal, and environmental health, promoting the attainment of the **Sustainable Development Goals**

National School of Public Health

NOVA UNIVERSITY LISBON

Thank you!

Carla Martins

carla.martins@ensp.unl.pt