OECD ENVIRONMENTAL JUSTICE CONFERENCE 2024

Unequal Health Burden of Particulate Matter : Addressing Environmental Justice Through Health Disparities Research

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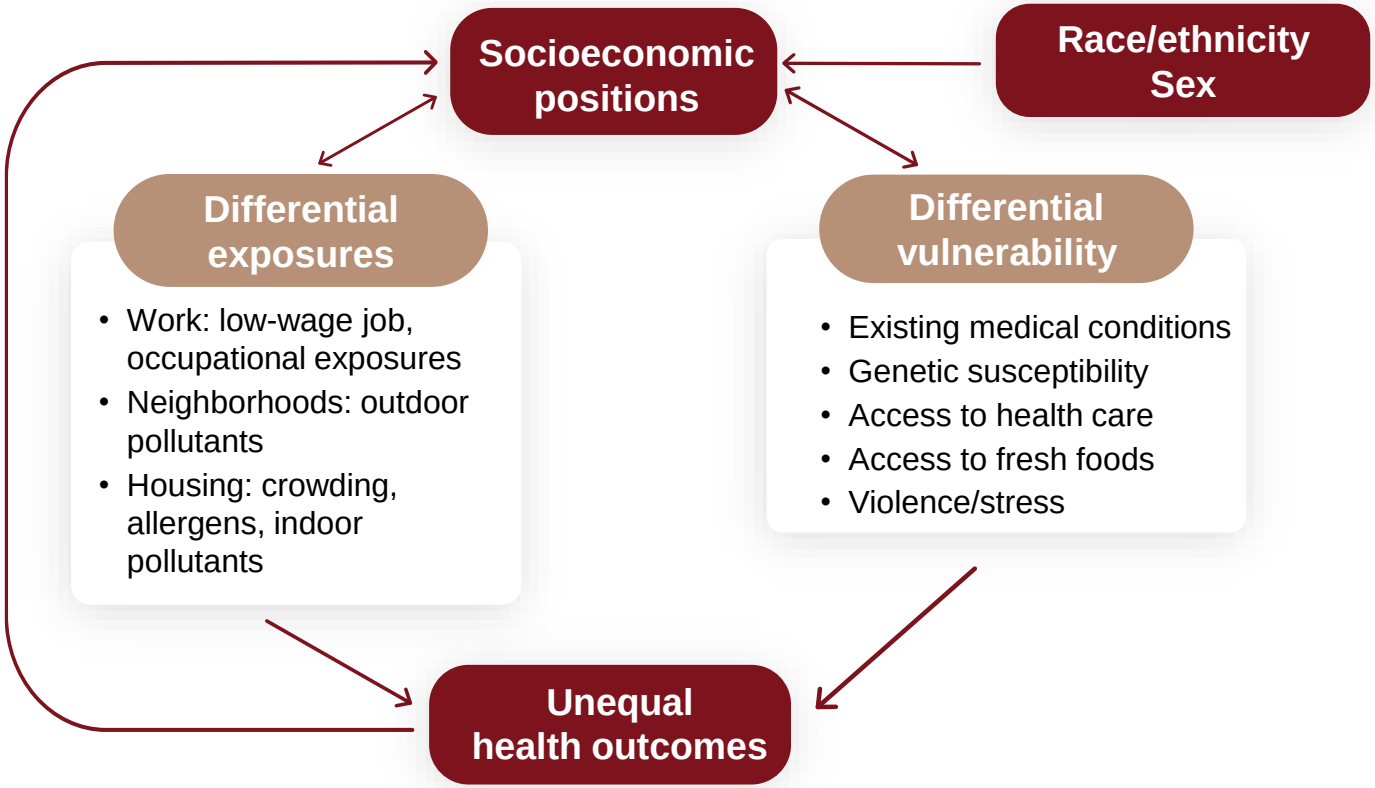
Introduction

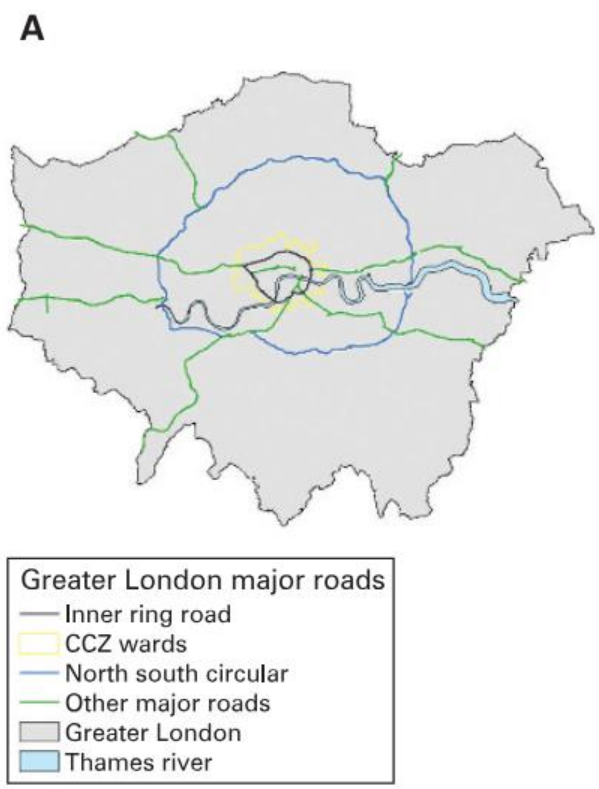
Unequal health burden of particulate matter (PM)[1]

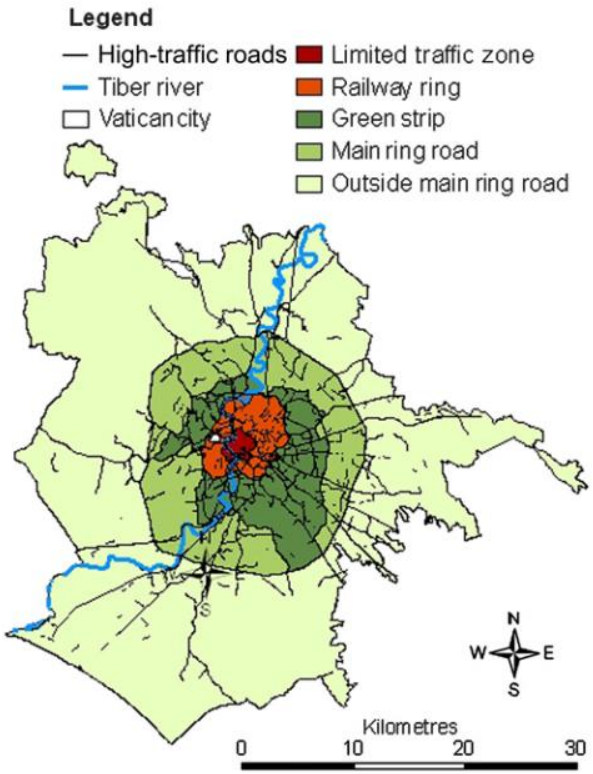


[1] O'Neill, M. S., Jerrett, M., Kawachi, I., Levy, J. I., Cohen, A. J., Gouveia, N., ... & Workshop on Air Pollution and Socioeconomic Conditions. (2003). Health, wealth, and air pollution: advancing theory and methods. Environmental health perspectives, 111(16), 1861-1870.

Introduction

To alleviate traffic congestion and reduce traffic-related air pollution, **London** and **Rome** introduced the congestion charging scheme:





Introduction

In London, the **most deprived areas** experienced greater air pollution reductions and mortality benefits compared to the least deprived areas[1]

Region	Pre-CCS PM_{10} concentration	Post-CCS PM_{10} concentration	Post-Pre difference	Years of life gained during 10 years per 100,000
1 (Least deprived)	25.73	25.72	-0.01	**3**
2	26.50	26.47	-0.03	**8**
3	26.73	26.70	-0.03	**8**
4	27.02	26.97	-0.05	**13**
5 (Most deprived)	27.62	27.54	-0.08	**20**

* Congestion Charging Scheme (CCS) during 2003.02. ~ 2007.02.

[1] Tonne, C., Beevers, S., Armstrong, B., Kelly, F., & Wilkinson, P. (2008). Air pollution and mortality benefits of the London Congestion Charge: spatial and socioeconomic inequalities. Occupational and Environmental Medicine, 65(9), 620-627.

Introduction

In Rome, the **least deprived areas** experienced greater air pollution reductions and mortality benefits compared to the most deprived areas[1].

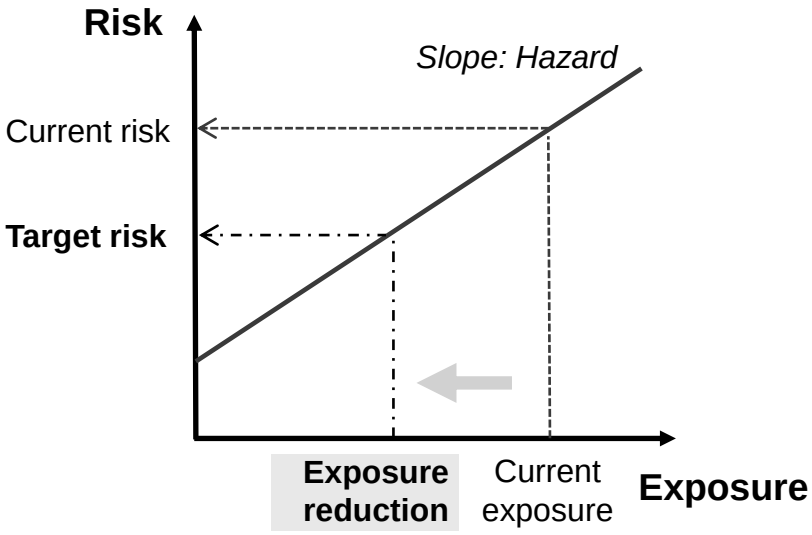
Region	Pre-CCS PM_{10} concentration	*Expected* Post-CCS PM_{10} concentration	*Expected* Post-Pre Difference	Years of life gained during 15 years per 100,000
1 (Least deprived)	8.69	8.49	-0.20	**229**
2	9.25	9.08	-0.17	**198**
3	8.77	8.67	-0.10	**118**
4	8.56	8.46	-0.10	**115**
5 (Most deprived)	7.83	7.78	-0.05	**59**

* Low Emission Zone during 2001 ~ 2005

[1] Cesaroni, G., Boogaard, H., Jonkers, S., Porta, D., Badaloni, C., Cattani, G., ... & Hoek, G. (2012). Health benefits of traffic-related air pollution reduction in different socioeconomic groups: the effect of low-emission zoning in Rome. Occupational and environmental medicine, 69(2), 133-139.

Introduction

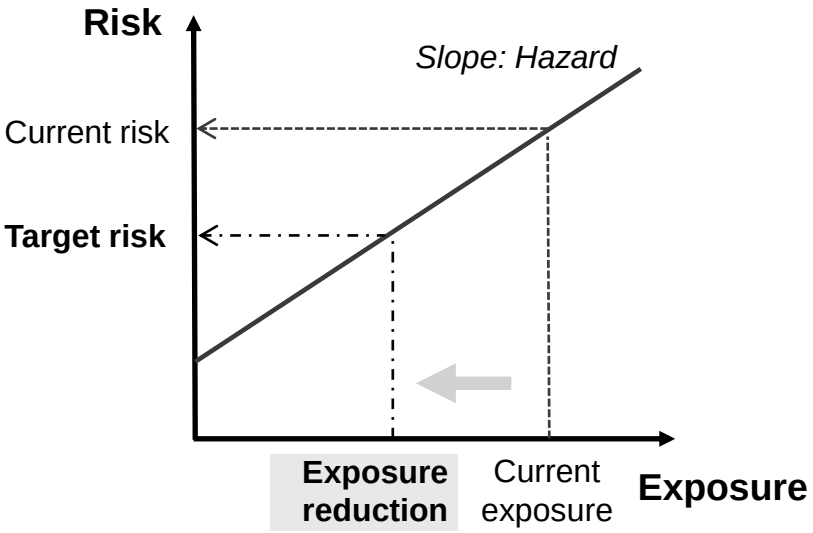
Risk = Exposure x Hazard

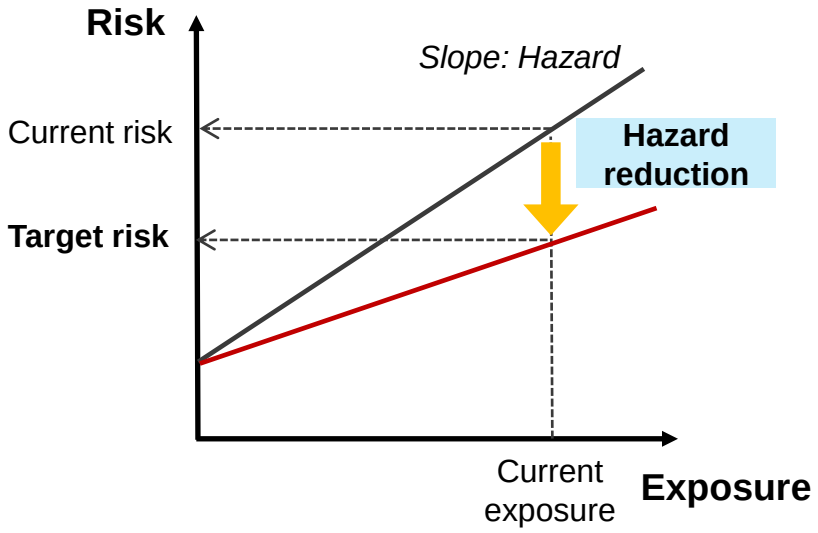


Introduction

The **hazard** associated with PM depends on its **composition** and **population vulnerability**

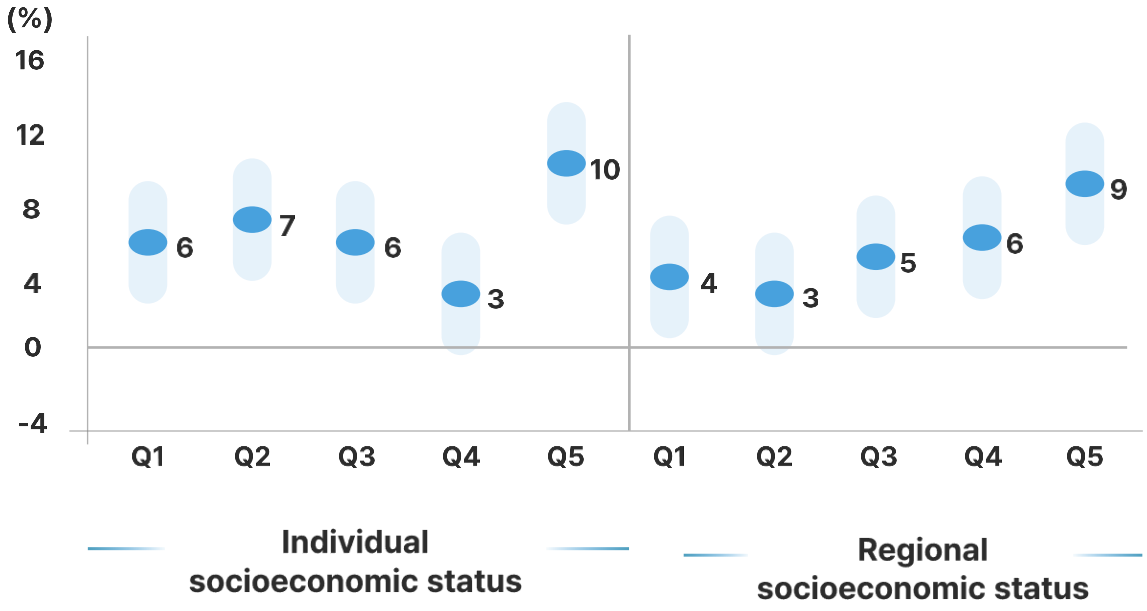
Risk = Exposure x Hazard → **Risk = Exposure x Hazard**





Recent Research on Environmental Health Disparities

People with low socioeconomic status or those living in deprived regions experience higher health risks associated with PM_{10}[1]



[1] Kim, S. Y., O'Neill, M. S., Lee, J. T., Cho, Y., Kim, J., & Kim, H. (2007). Air pollution, socioeconomic position, and emergency hospital visits for asthma in Seoul, Korea. International archives of occupational and environmental health, 80(8), 701-710.

Recent Research on Environmental Health Disparities

Regions with limited medical resources or greenness
experience higher health risks associated with $PM_{2.5}$[1]

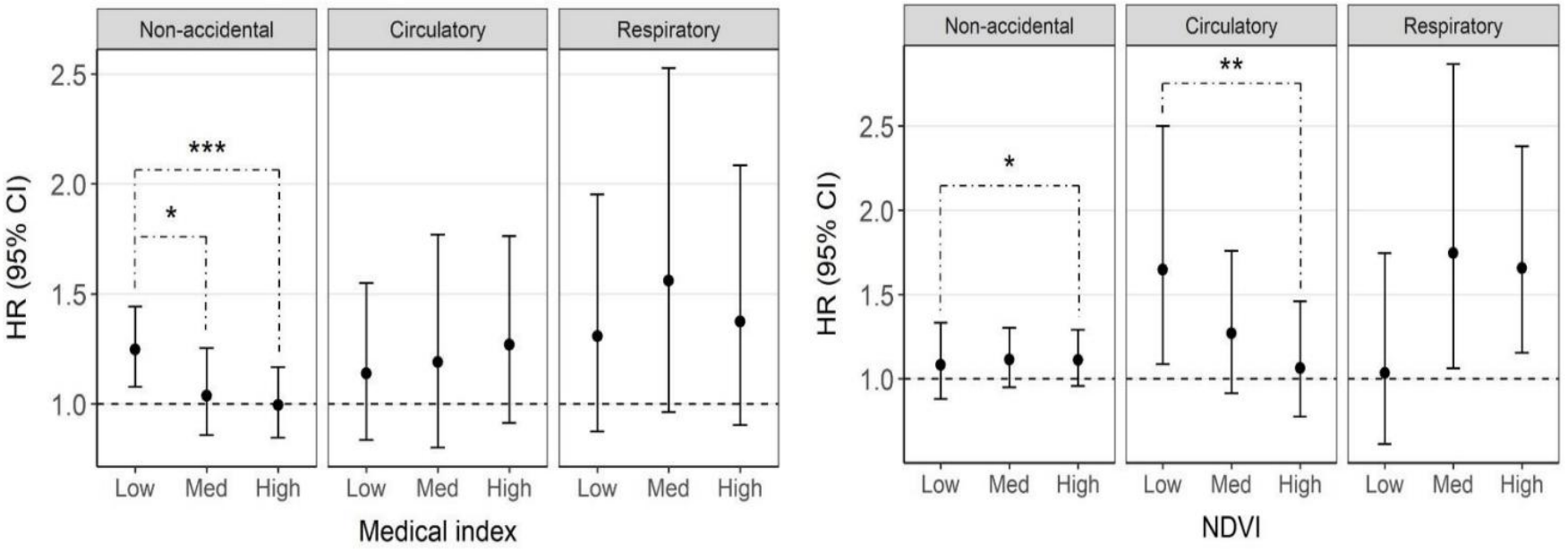


Figure 3. Associations between $PM_{2.5}$ and cause-specific mortality stratified by community-level variables: Medical index and NDVI (normalized difference vegetation index)

[1] Byun, G., Kim, S., Choi, Y., Kim, A., Team, A. C., Lee, J. T., & Bell, M. L. (2024). Long-term exposure to $PM_{2.5}$ and mortality in a national cohort in South Korea: effect modification by community deprivation, medical infrastructure, and greenness. BMC Public Health, 24(1), 1-12.

Recent Research on Environmental Health Disparities

People with disabilities experience higher health risks associated with PM_{10}[1]

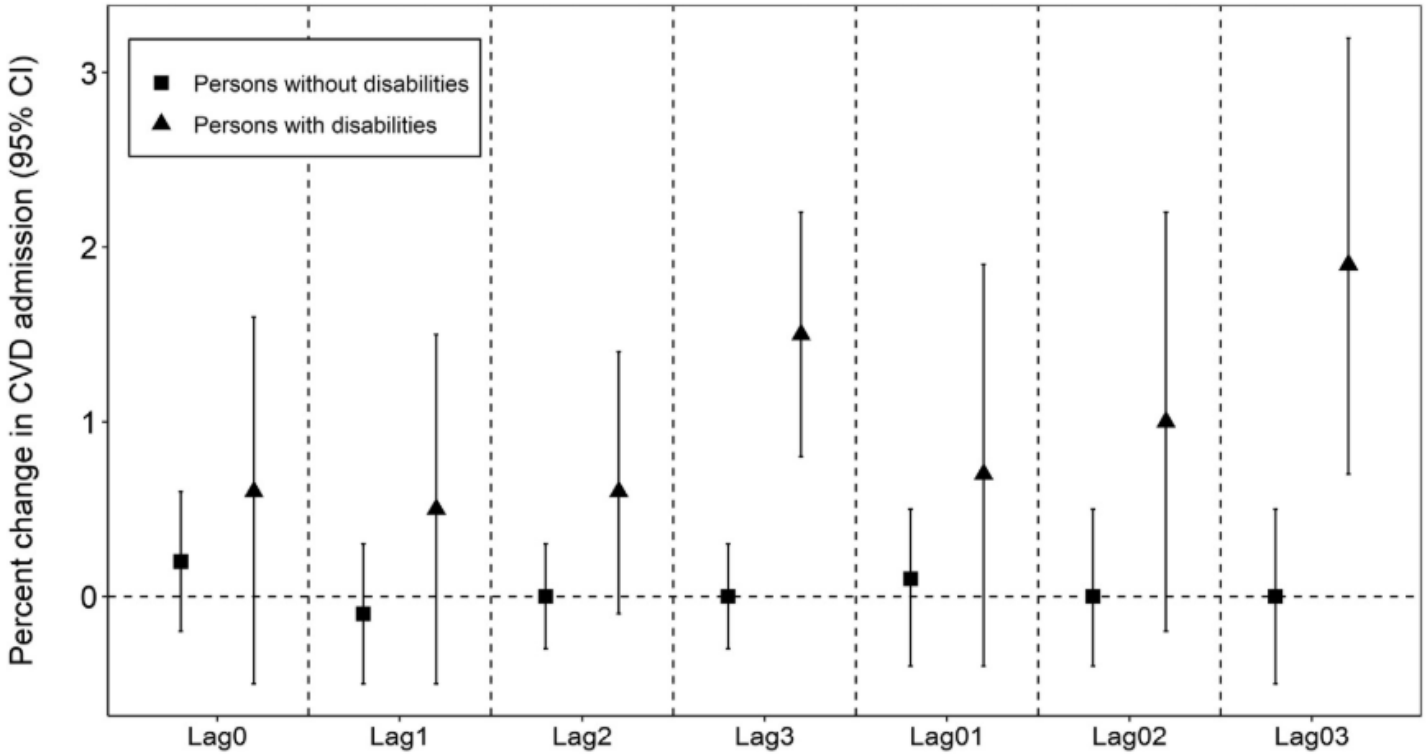


Fig. 1. Percent change in cardiovascular admissions per 10 μg/m3 increase in PM10 by existence of a disability across different lag structures.

*Lag(0)=current day; Lag(1)= a previous day; Lag(*i*)= *i* days ago

[1] Kim, S., & Lee, J. T. (2022). Short-term exposure to PM_{10} and cardiovascular hospitalization in persons with and without disabilities: Invisible population in air pollution epidemiology. Science of The Total Environment, 848, 157717.

Recent Research on Environmental Health Disparities

Differential toxicity of various sources and components of $PM_{2.5}$ mixture[1]

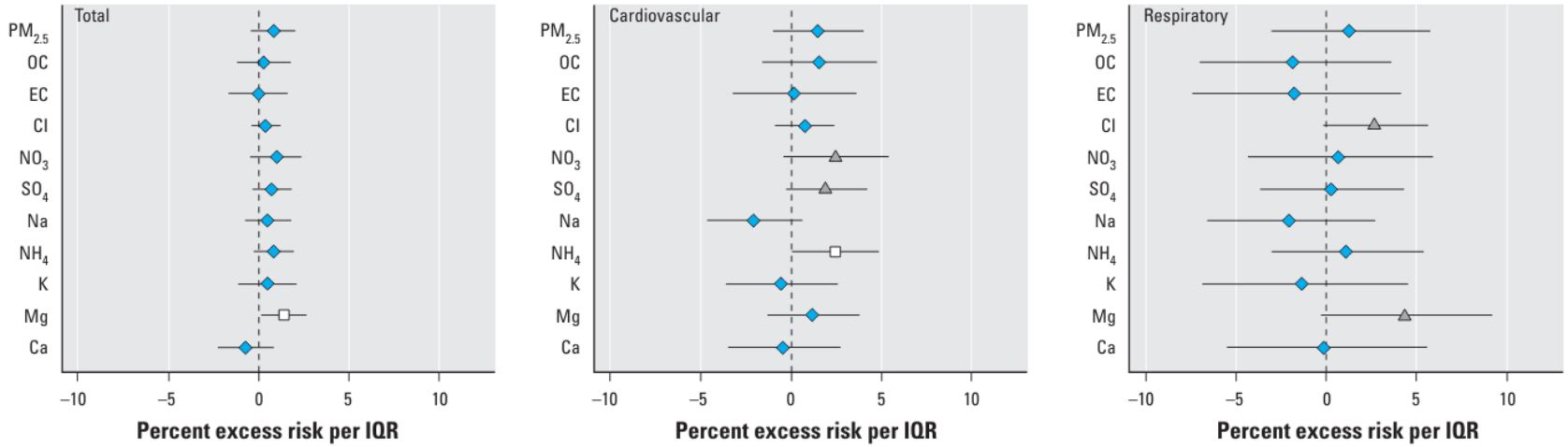


Figure 3. Percent change in risk for total (*A*), cardiovascular (*B*), and respiratory (*C*) mortality per IQR increase in $PM_{2.5}$ mass and chemical components. Points represent central estimates, and horizontal lines represent 95% CIs.

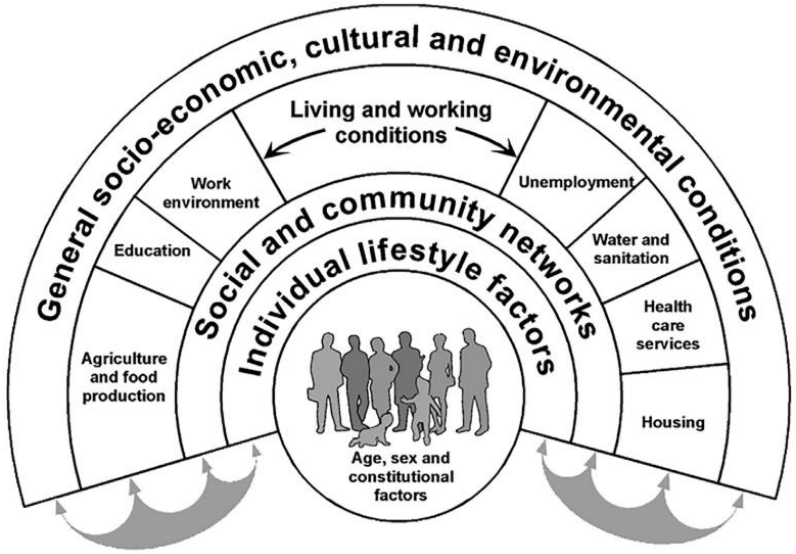
IQR: interquartile range=25th -75th

[1] Son, J. Y., Lee, J. T., Kim, K. H., Jung, K., & Bell, M. L. (2012). Characterization of fine particulate matter and associations between particulate chemical constituents and mortality in Seoul, Korea. *Environmental Health Perspectives*, 120(6), 872-878.

Recent Research on Environmental Health Disparities

The Contextual Factors Determining the Hazard of PM

- Individual/Regional socioeconomic status
- Disability characteristics
- Regional medical infrastructure
- Residential greenness
- PM emission sources and compositions



Dahlgren, G., & Whitehead, M. (1991). Policies and strategies to promote social equity in health. Stockholm: Institute for future studies.

Conclusion

- The **health effects of particulate matter (PM) vary** not only with mass concentration but also **depending on the context** encompassing time, place, and population groups.

- If policies are implemented without considering these context, health inequalities associated with PM may actually worsen.

- From the perspective of environmental justice, future PM management should move towards **customized policies that take this context into account**.

Thank you.