

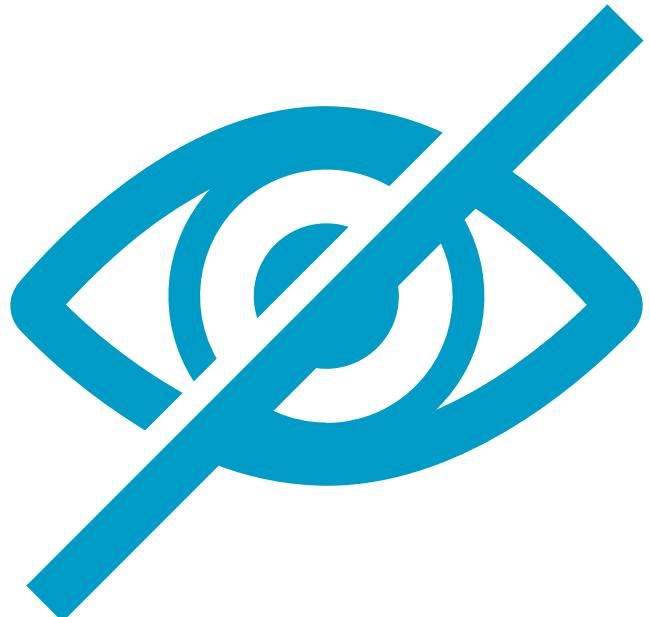


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Life's invisible influences & Introducing the Exposome

Anika Bains and Mike Wilson

Agenda



- Why are we looking at the Invisible influences?
- Introduction to the exposome
- Air pollution & Green spaces
- Noise & Light pollution
- Micro-plastics



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Introducing the exposome



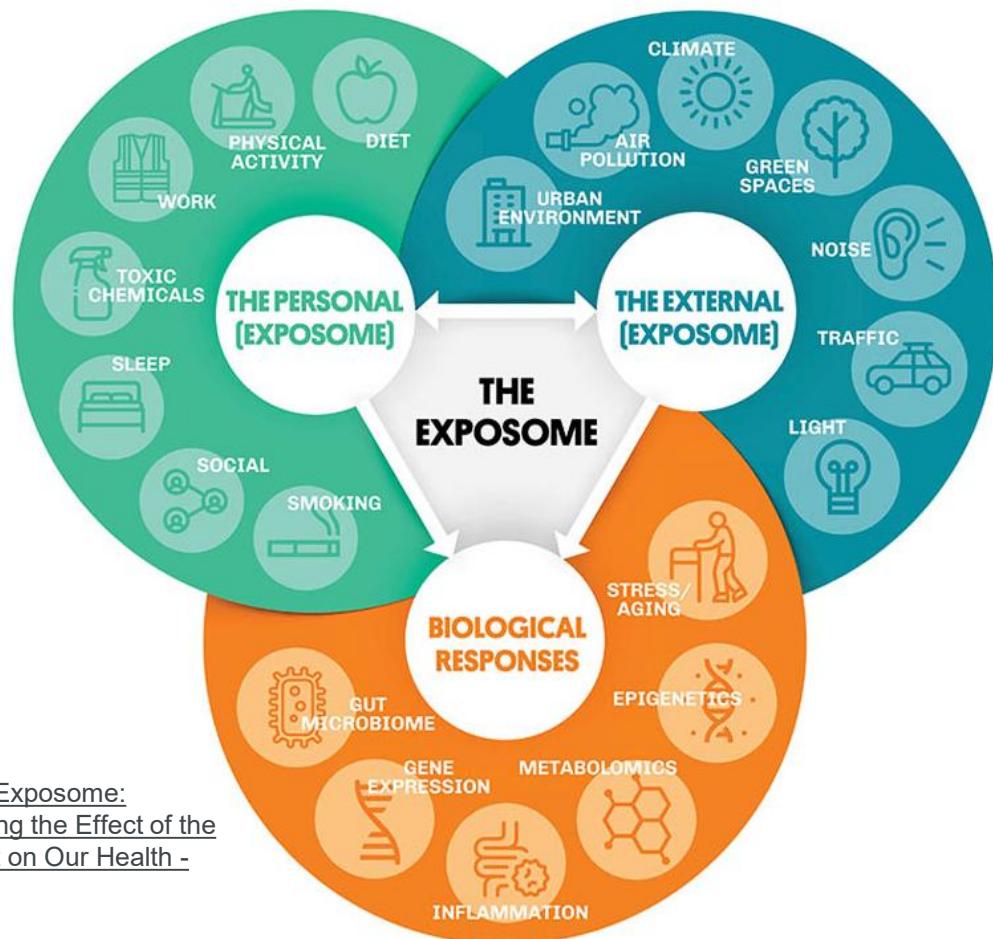
- Nature vs nurture
- Environment influences biology
- E.g. environment can impact genetic expression (epigenetics)
- Exposures in one phase of life can have immediate or delayed consequences



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Introducing the exposome

ISGlobal



- 'Exposome' first appeared in 2005
- A way to describe the totality of environmental exposures an individual experiences throughout life
- Complements 'genetics'
- Some aspects are easier to control than others
- Today we focus on a selection of ambient, external exposures.

Image: The Exposome:
Understanding the Effect of the
Environment on Our Health -
ISGLOBAL



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Air pollution

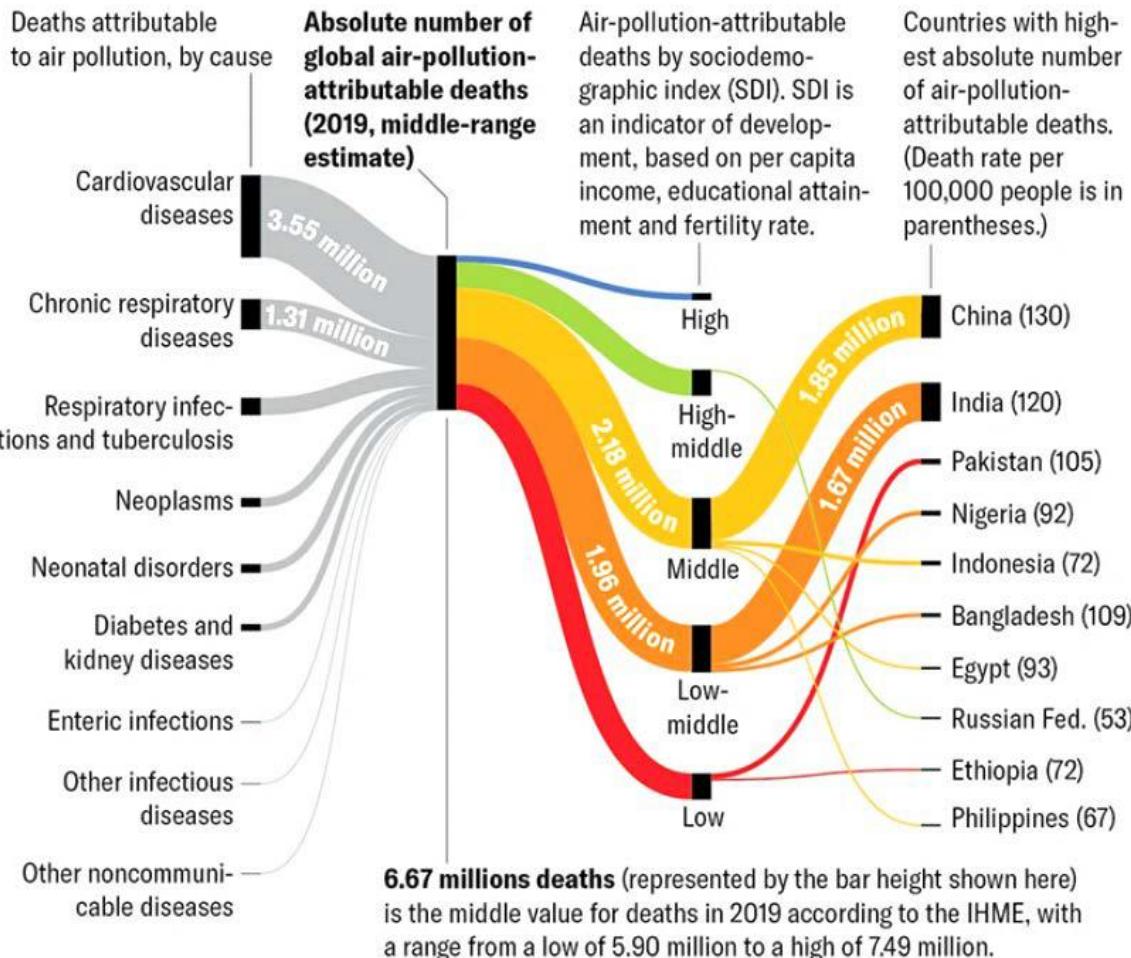


- Relatively well-studied area
- 2020 - first UK death recognised as having air pollution as a contributing factor
- Pollution on London's South Circular Road led to dangerously high NO₂ and PM levels.
- In reality, many more deaths than this
- Lack of recognition due to insidious nature of impact



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Air pollution



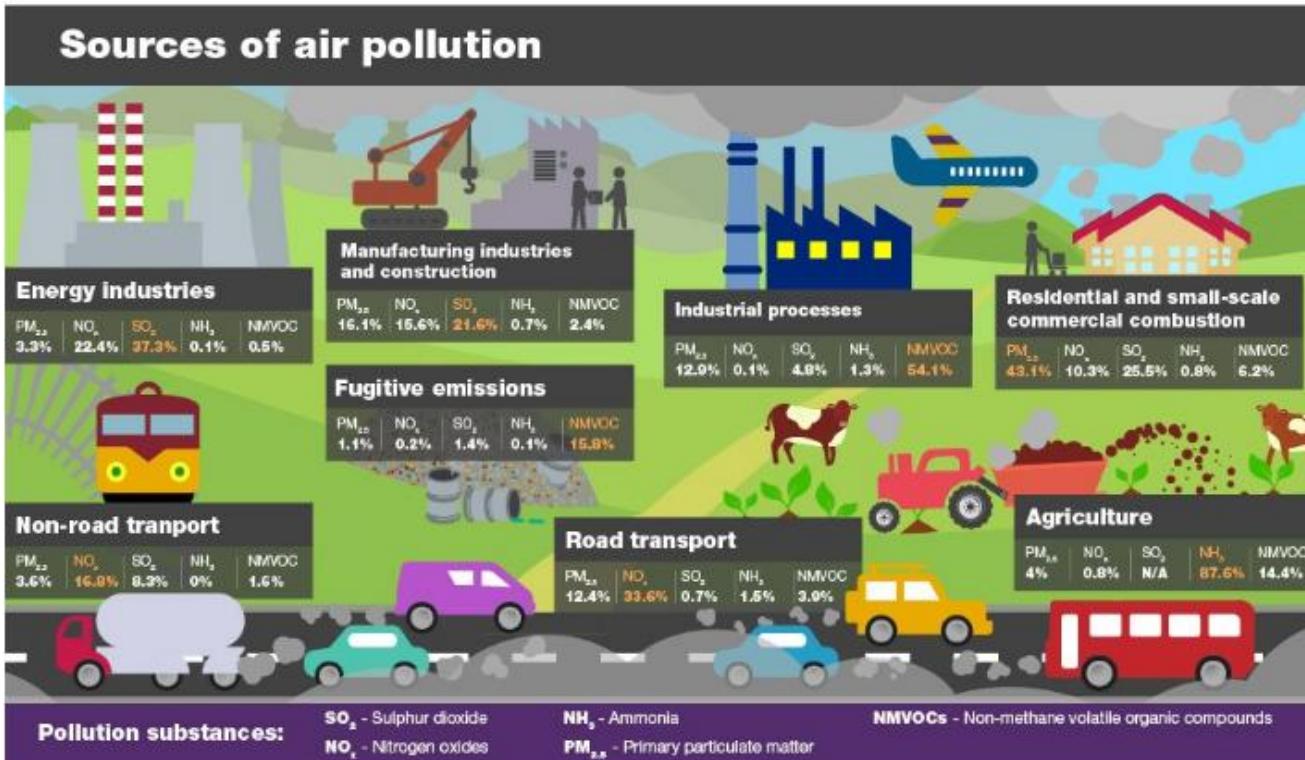
- Pollution Includes dust, fumes, gas, mist, odour, smoke, vapour
- Small particles have wider potential consequences
- Associated health problems include asthma, respiratory infections, stroke, heart disease
- Disproportionately affects lower-income populations
- High-income countries not immune

Madhusoodanan J. Fixing air pollution could dramatically improve health disparities.
Nature. 2023;621(7979):S30–4. doi:10.1038/d41586-023-02614-5.



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Air pollution

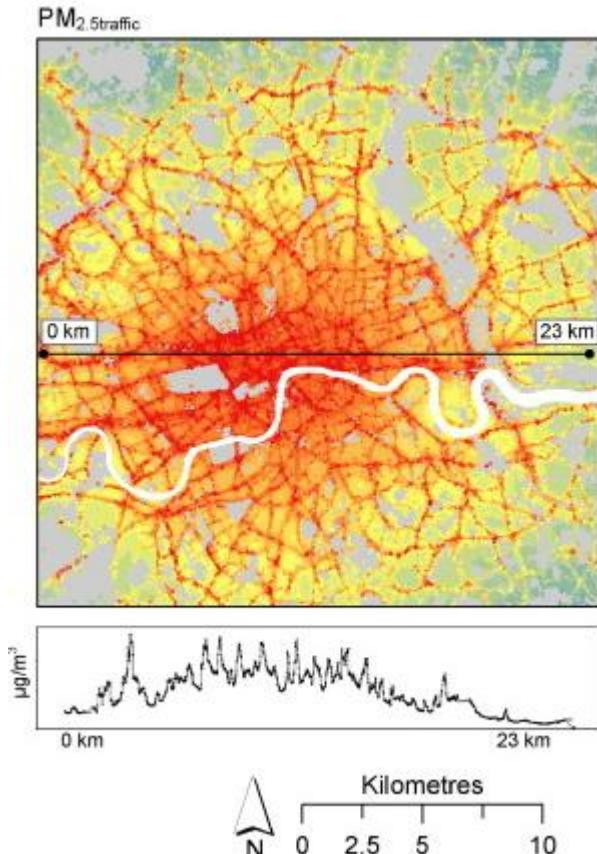


Office for Health Improvement and Disparities. *Air pollution: applying All Our Health* [Internet]. London: GOV.UK; published 20 Feb 2020, updated 28 Feb 2022 [cited 2025 Dec 16]. Available from: <https://www.gov.uk/government/publications/air-pollution-applying-all-our-health/air-pollution-applying-all-our-health>

- Office for Health Improvement and Disparities considers air pollution the nation's largest environmental risk.
- 28,000 to 36,000 deaths per year
- 6% of all deaths
- Most, but not all, threats outdoors
- Cost of health impacts £25-50bn per year



Air pollution



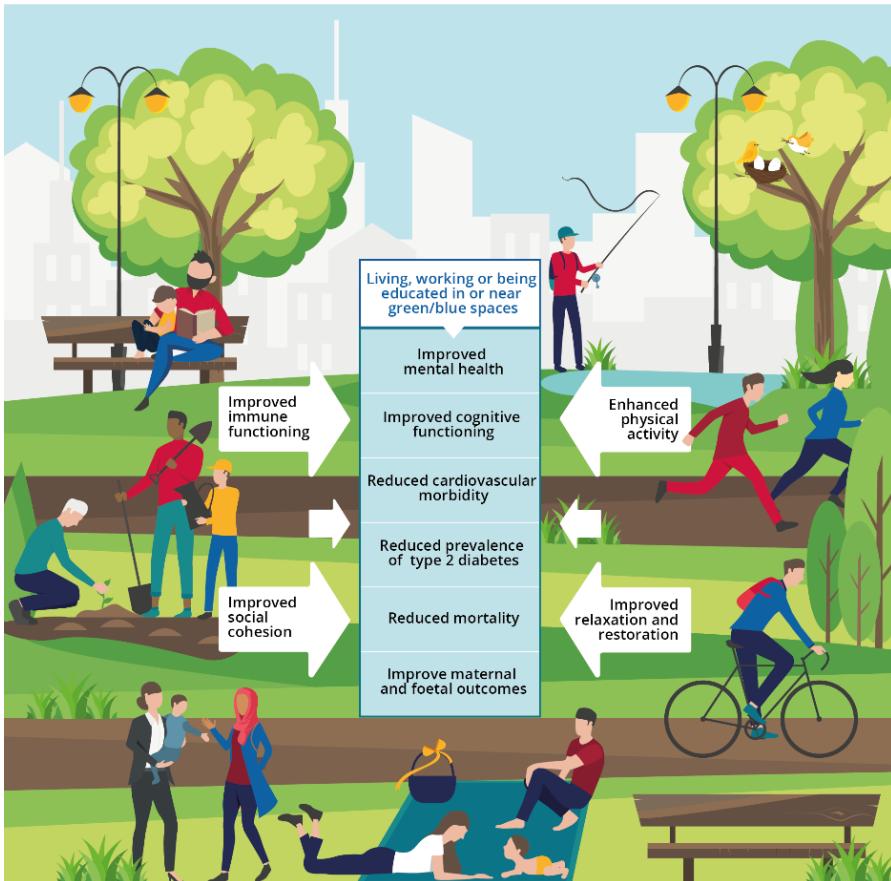
- Impacts can be very localised
- Historically driven by prevailing air flows (eastern areas worse)
- Now, key factors include traffic, local land use (industrial zones, depots)
- Urban topology, e.g. 'street canyons, can trap pollutants
- Local problems can have local solutions, like low emission zones

Fecht D, Hansell AL, Morley D, Dajnak D, Vienneau D, Beevers S, et al. Spatial and temporal associations of road traffic noise and air pollution in London: Implications for epidemiological studies. *Environ Int.* 2016 Mar;88:235–242.
doi:10.1016/j.envint.2015.12.001.



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Green spaces



- Some difficulty determining if green spaces are independently associated with health?
- WHO state there are many public health benefits associated with them
- Physical benefits include via reducing temperatures, and reductions in air/noise pollution
- Mental health benefits include those from relaxation and exercise

European Environment Agency. Who benefits from nature in cities? Social inequalities in access to urban green and blue spaces across Europe [Internet]. Copenhagen: European Environment Agency. Available from: <https://www.eea.europa.eu/en/analysis/publications/who-benefits-from-nature-in-cities-social-inequalities-in-access-to-urban-green-and-blue-spaces-across-europe>. Accessed 2025 Dec 16.



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UK Clean Air Zones

Live cleanest city ranking

Real-time United Kingdom cleanest city ranking

#	Cities	AQI [†] US
1	🇬🇧 Cheltenham	12
2	🇬🇧 Chorley	12
3	🇬🇧 Cambridge	14
4	🇬🇧 Leeds	16
5	🇬🇧 Pontypridd	17
6	🇬🇧 Kendal	21
7	🇬🇧 Salisbury	23
8	🇬🇧 Oxford	24
9	🇬🇧 Birmingham	27
10	🇬🇧 Devizes	28

2024 United Kingdom cleanest city

Dunblane, Scotland

12

Live most polluted city ranking

Real-time United Kingdom most polluted city ranking

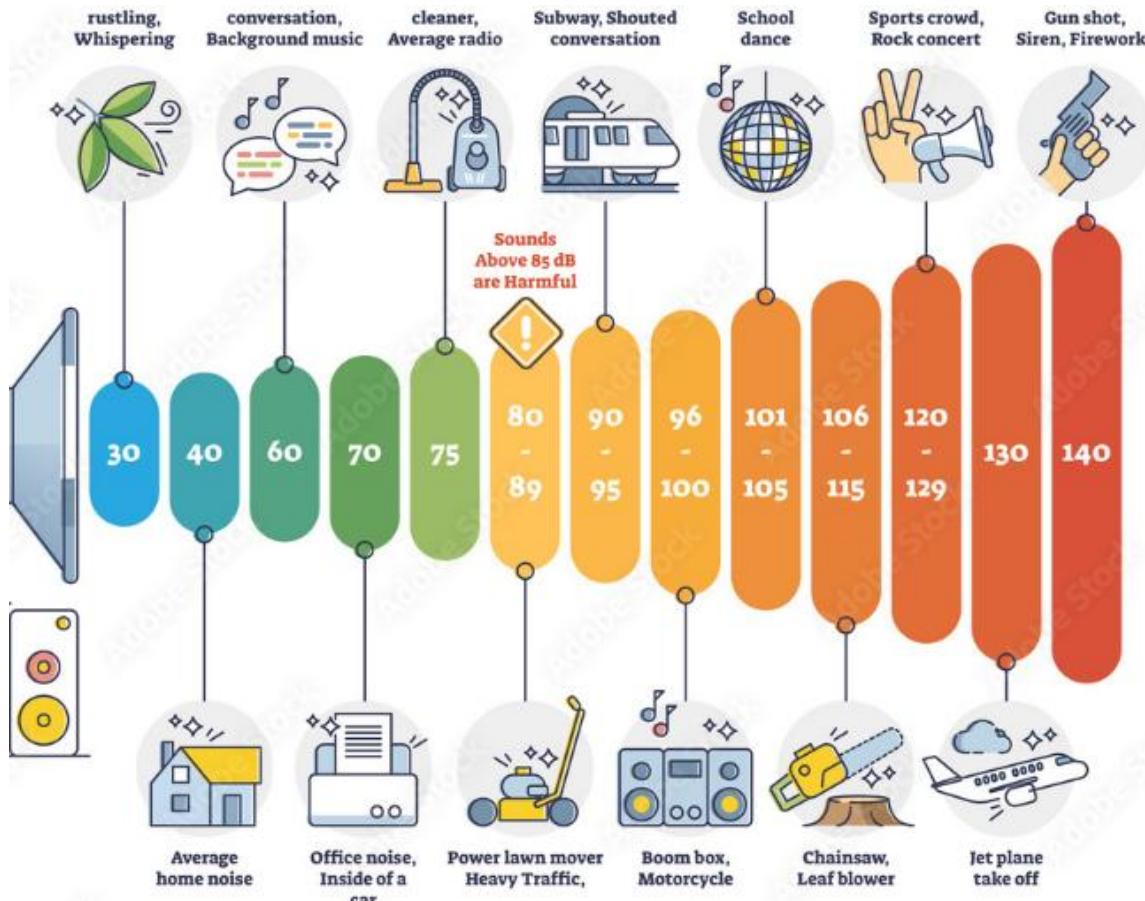
#	Cities	AQI [†] US
1	🇬🇧 Bradford	108
2	🇬🇧 Leicester	60
3	🇬🇧 Bristol	59
4	🇬🇧 Port Talbot	55
5	🇬🇧 Brighton	53
6	🇬🇧 Hackney	49
7	🇬🇧 Coventry	48
8	🇬🇧 London	44
9	🇬🇧 Scunthorpe	44
10	🇬🇧 Reading	41

2024 United Kingdom most polluted city

Northwood, England

55

Noise pollution



Decibel scale measurement examples with dB volume comparison outline diagram [Internet]. 123RF; [cited 2025 Dec 16]. Available from: https://tr.123rf.com/photo_172616900_decibel-scale-measurement-examples-with-db-volume-comparison-outline-diagram.html

- Potential wide-ranging impacts
- Most obvious: ear damage
- Other impacts include cardiovascular/metabolic, sleep disturbance and cognitive impairment in children
- EU estimate: 48,000 new cases of heart disease, and 12,000 premature deaths per year

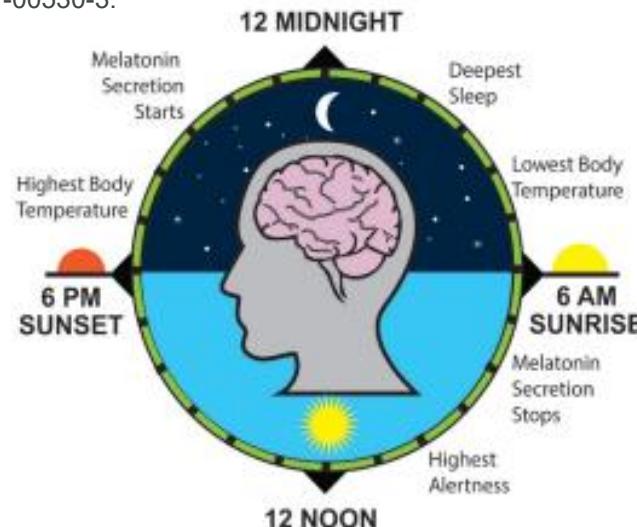


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Light pollution



Assessment of light pollution in Indian scenario: a case of Bangalore. J Inst Eng (India) Ser A. 2021 Jul;102(3).
doi:10.1007/s40030-021-00530-3.

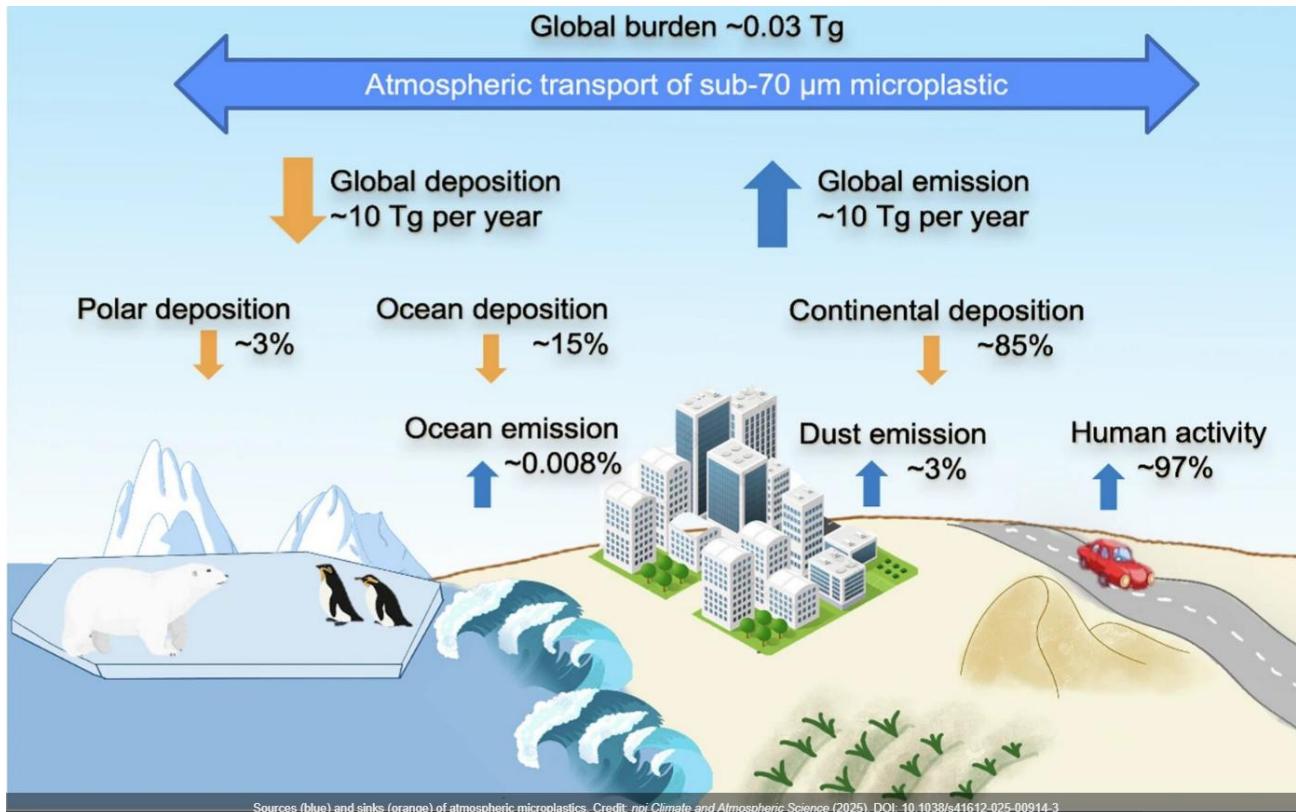


- Light pollution refers to excessive artificial light, especially at night
- Impacts on health often overlap with noise pollution
- Plausible links with obesity, diabetes, heart disease, high blood pressure, mental illness
- Those working night shifts especially vulnerable due to disrupted sleep patterns



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Microplastics



Müller D, Max Planck Society. Airborne microplastics: Where do they come from, where do they go? *Phys.org* [Internet]. 2025 Mar 7 [cited 2025 Dec 15]. Available from: <https://phys.org/news/2025-03-airborne-microplastics.html>

Background

- Technically any plastic below 5mm, but health concerns relate to the smallest
- Humanity produces 350 million tonnes of plastic per year, growing to ~1bn tonnes by 2050



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Where are microplastics found?



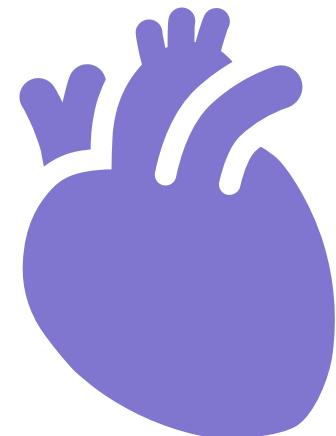
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Recent Studies

Exposure is linked to a wide range of health impacts at all stages of Life but the validity of some studies has been questioned.



Change in behaviour like those seen in older mice or those with neurological disease



4.5 x more likely to have a stroke or heart attack



Level of microplastics were 3-5 x higher in dementia patients



Study (1) "Acute Exposure to Microplastics Induced Changes in Behavior and Inflammation in Young and Old Mice." *International Journal of Molecular Sciences*

Study (2) "Microplastics and Nanoplastics in Atheromas and Cardiovascular Events." *The New England Journal of Medicine*

Study (3) "Bioaccumulation of microplastics in decedent human brains." *Nature Medicine*



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Reducing Microplastic Exposure - Kitchen

Choose Reusable Products

- Replace single-use plastics with reusable bottles, bags, and containers.
- Use glass, stainless steel, or ceramic for storage and heating.

Cook Smart

- Avoid heating food in plastic – heat accelerates microplastic release.
- Swap plastic chopping boards for bamboo, glass, or wood.
- Retire scratched non-stick pans; choose stainless steel, cast iron, or ceramic.

Food Tips

- Rinse rice before cooking (can cut microplastics by 20-40%).
- Opt for loose-leaf tea over plastic tea bags.
- Reduce processed foods and consider limiting seafood.



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Reducing Microplastic Exposure - Home



- **Choose natural fibres** - Select clothing and bedding made from cotton, wool, hemp, or bamboo.
- **Wash synthetic clothes less often**, use cold water, and line-dry when possible to reduce fibre shedding.
- **Check the labels** - Friendly cleaning products
- **Dust & Clean regularly**



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Invisible influences & Inequality

Is there a link between “invisible influences” and inequality?

Yes — exposure isn’t evenly distributed.

- **Environmental exposure** – Lower-income communities are more likely to live near busy roads and industrial areas, meaning higher levels of traffic pollution and noise.
- **Night-shift work** – Often taken by lower-income groups, exposing them to artificial light at night and disrupting circadian rhythms.
- **Cost of healthier choices** – Safer, non-toxic or organic products are typically more expensive; plastic and polyester remain cheaper than glass, ceramic or natural fibres.

But it's not only a deprivation story.

Counterpoints:

- **Affluent areas can face risks too** – For example, Northwood has high pollution levels despite being relatively wealthy, likely due to heavy car use.
- **Living near green space isn't always protective** – Some green areas, such as golf courses, can come with unexpected health risks (e.g., pesticide exposure).



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Questions

Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenters.



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