

The Economic Impact of Unsustainable Chemicals Management and Possible Solutions

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Chemical Pollution is the 3rd Global Crisis...

and an enormous burden on human and economic development

- United Nations

- We are changing the composition of the natural environment: atmosphere, soils, water in a manner that makes people sick, disabled, and suffering.
- We are losing human and environmental productivity: GDP, natural capital, growth.
- We are undermining human values: poverty, injustice, progress, health.
- The cost of exposure to environmental chemicals exceeds 10% of the global GDP (Grandjean, Bellanger, 2017).
- Is this tradeoff acceptable or inevitable to end poverty globally? What about a livable planet?

The devastation of Lead (Pb) poisoning

Many sources: pipes, soil, foods, ceramics, cosmetics, artisanal medicines, battery recycling, paints, cookware, toys, paint, cables, ...

46% of children and adults in Low and Middle Income Countries (LMICs) have blood lead levels (BLL) $> 5 \mu\text{g/dL}$

As many as 28% of children and adults in LMICs may have BLL $> 10 \mu\text{g/dL}$

- The US Center for Disease Control (CDC) uses a reference value of $3.5 \mu\text{g/dL}$ to identify children with elevated BLLs.
- The mean BLL for U.S. adults is less than $1 \mu\text{g/dL}$.

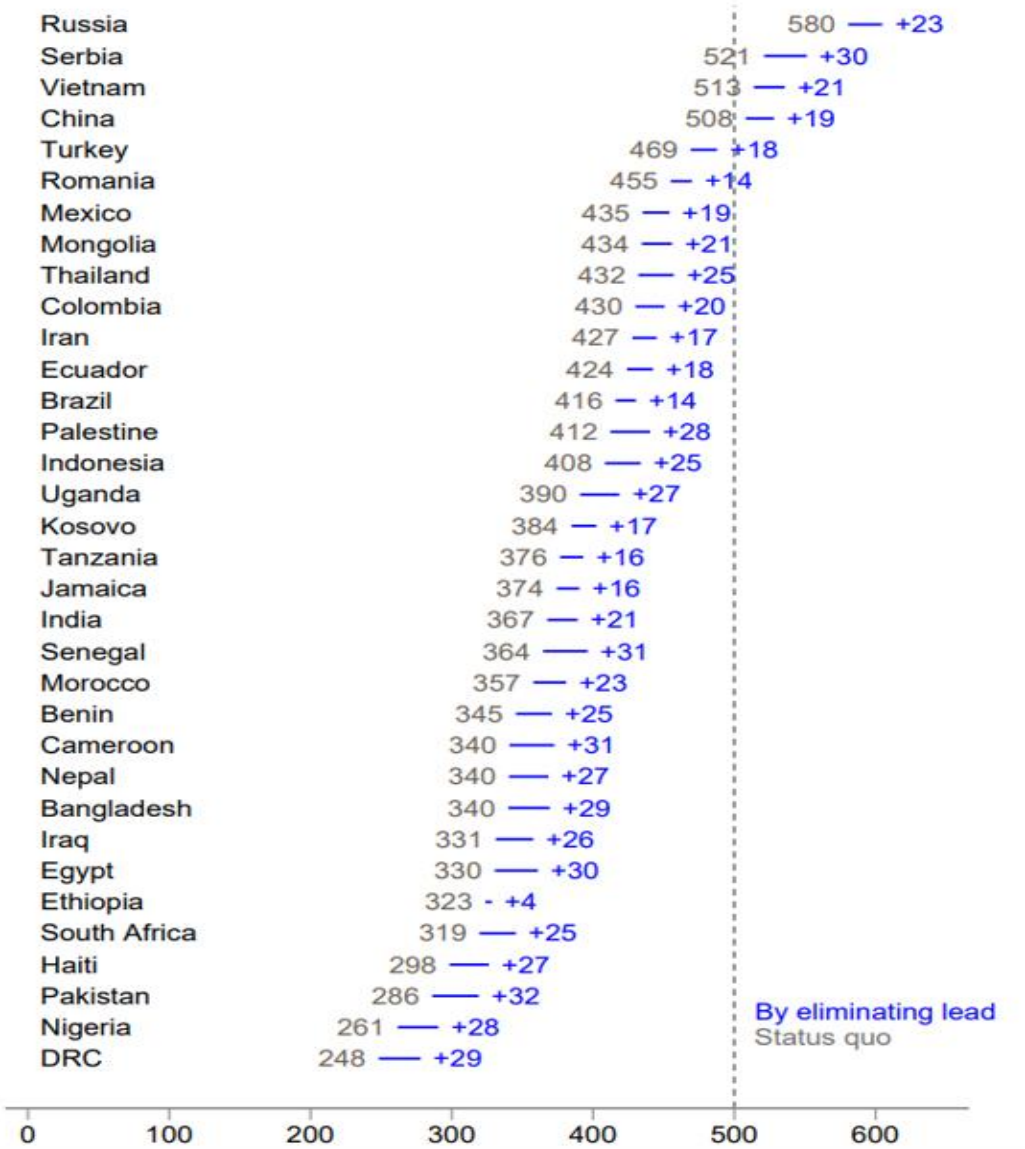
There is no safe level for exposure to lead.



Young girl wearing Kohl, a cosmetic found to contain lead.

(New York City Health Department, 2012. eurekalert.org/multimedia/759222)

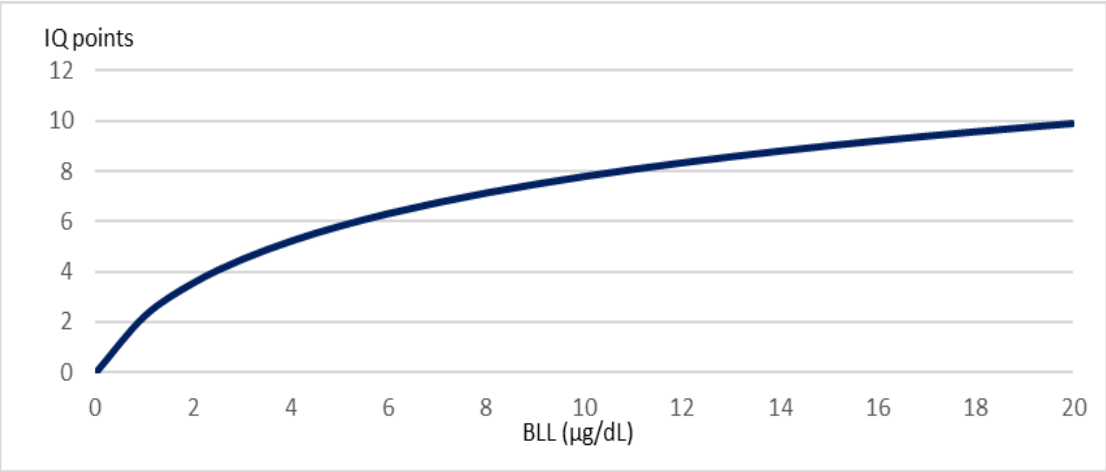
Severe impact on learning in developing countries



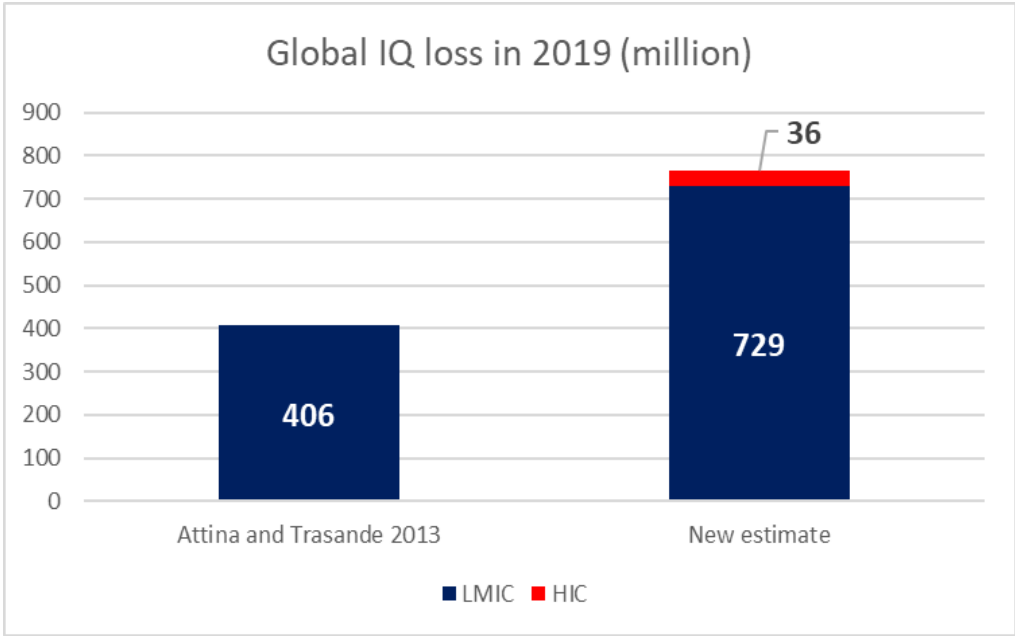
Effect of BLL on learning outcomes (Harmonized Learning Outcomes scores).

Lee Crawford et al., How much would reducing lead exposure improve children’s learning in the developing world?”, Centre for Global Development working paper, July 2023

IQ points lost: IQ of 100 is considered average, 80 is very low.



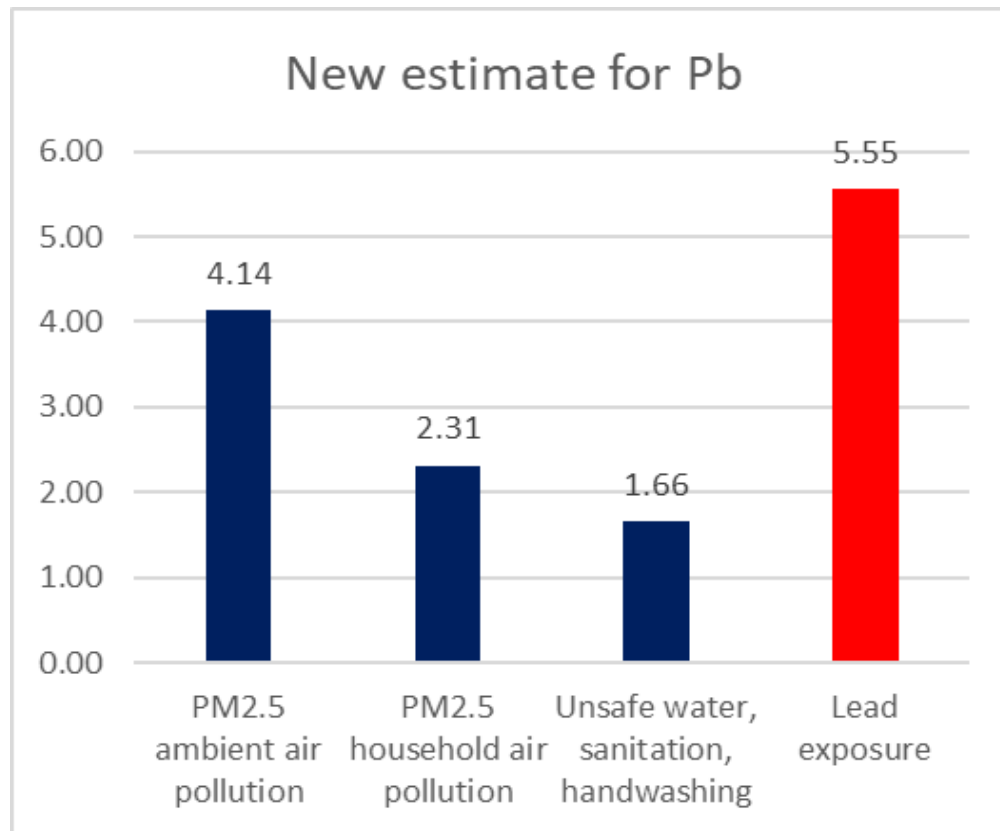
IQ losses from Lead is 80% higher than previous estimates.



World Bank 2023 (forthcoming)

Lead exposure contributes to high blood pressure and cardiovascular disease (CVD).

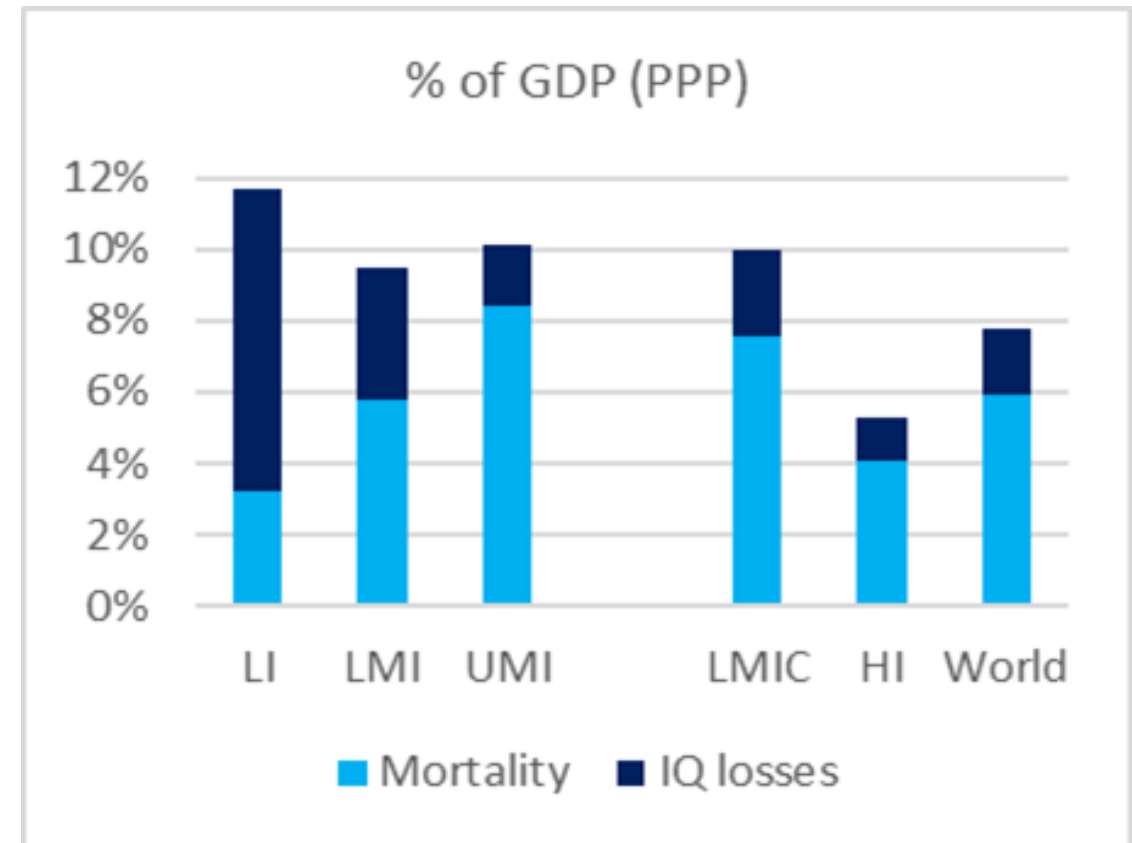
Mortality from Lead is 6 times higher than reported in the GBD 2019.



Million deaths per year.

Global Burden of Disease 2019; World Bank 2022: The Global Health Cost of PM2.5 Air Pollution - A Case for Action Beyond 2021; Bjorn Larsen, Ernesto Sánchez-Triana (forthcoming).

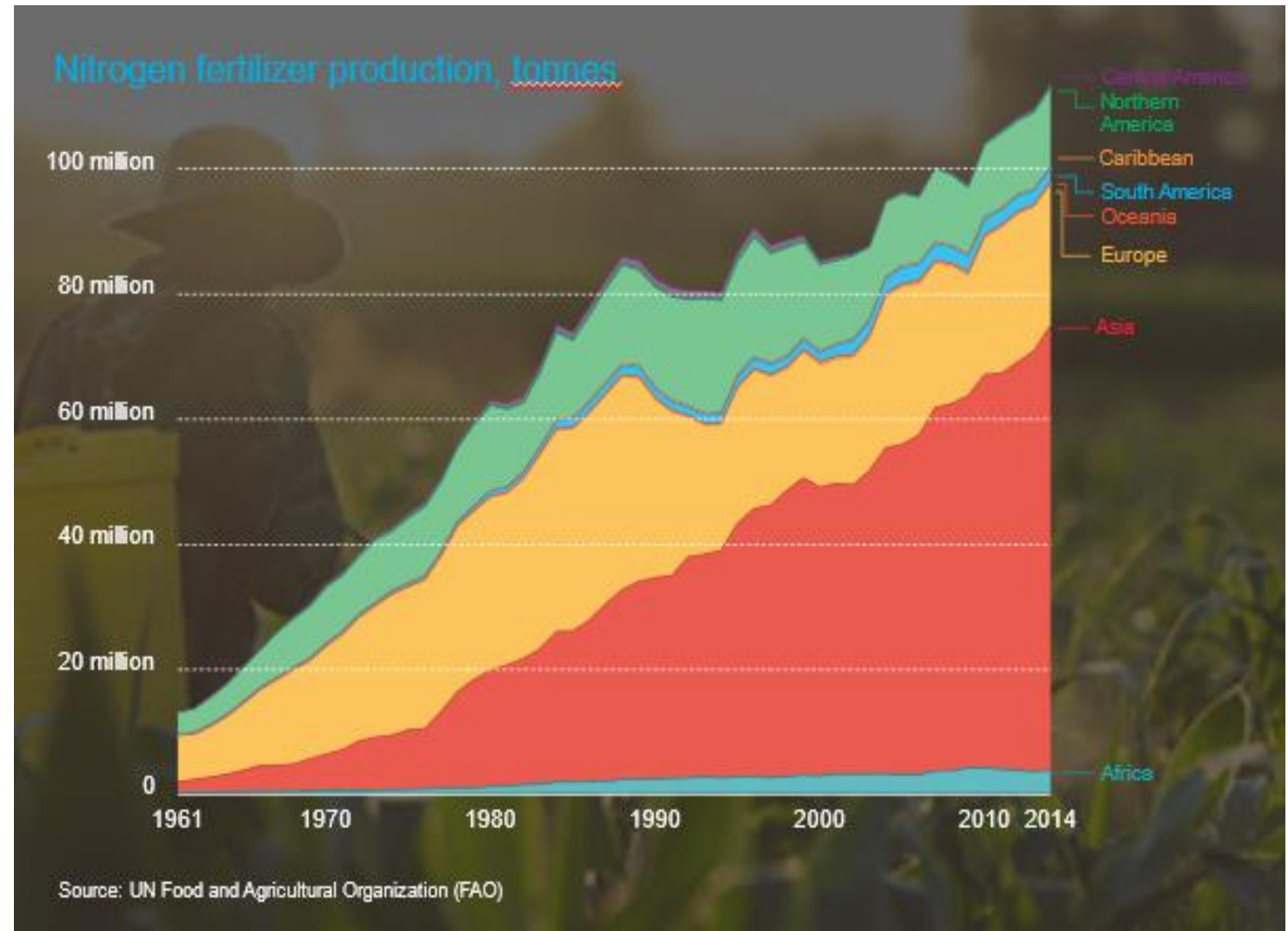
The global cost of the health effects of Lead exposure is I\$10.35 trillion, equivalent to 7.76 % of global GDP (PPP).



Low Income, Lower-Middle Income, Upper-Middle Income, Low and Middle Income Countries, High Income. I\$: International dollar (would buy a comparable amount of goods and services a US\$ buys in the US), PPP: Purchasing Power Parity. Intelligence Quotient, Gross Domestic Product.

- Nitrogen pollution is surpassing global boundaries ... and keeps rising.
- Fertilizers are highly subsidized – particularly in Asia.
- Other sources: waste water, cars, industry.
- Volatilized into air: Nitrous oxide is 300 times more potent at trapping heat than CO₂ – and contributes to air pollution.
- Leached into water: algae blooms cause dead zones (hypoxia).
- Fatal health impacts, especially on women and children.

Nitrogen – the quantity makes the poison



Health impacts of Nitrogen

Blue Baby Syndrome

Fatal diseases linked to Nitrates

Stunting in children

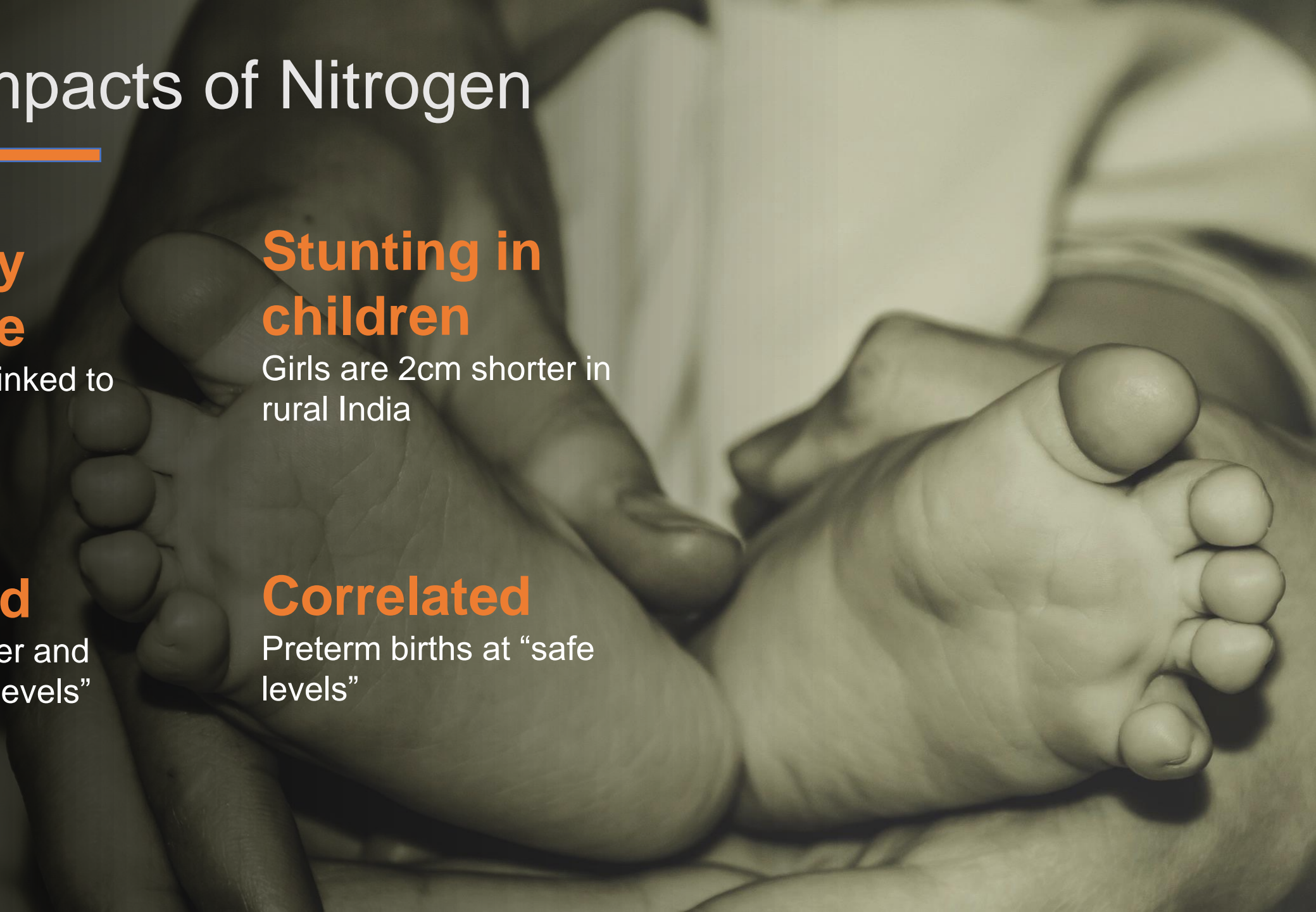
Girls are 2cm shorter in rural India

Correlated

Colorectal cancer and thyroid at “safe levels”

Correlated

Preterm births at “safe levels”



Bad trade off lead to high economic costs

10% increase in nitrogen use leads to:

▲ 1.7% Increase in yields



▼ 5.7% Decline in labor productivity



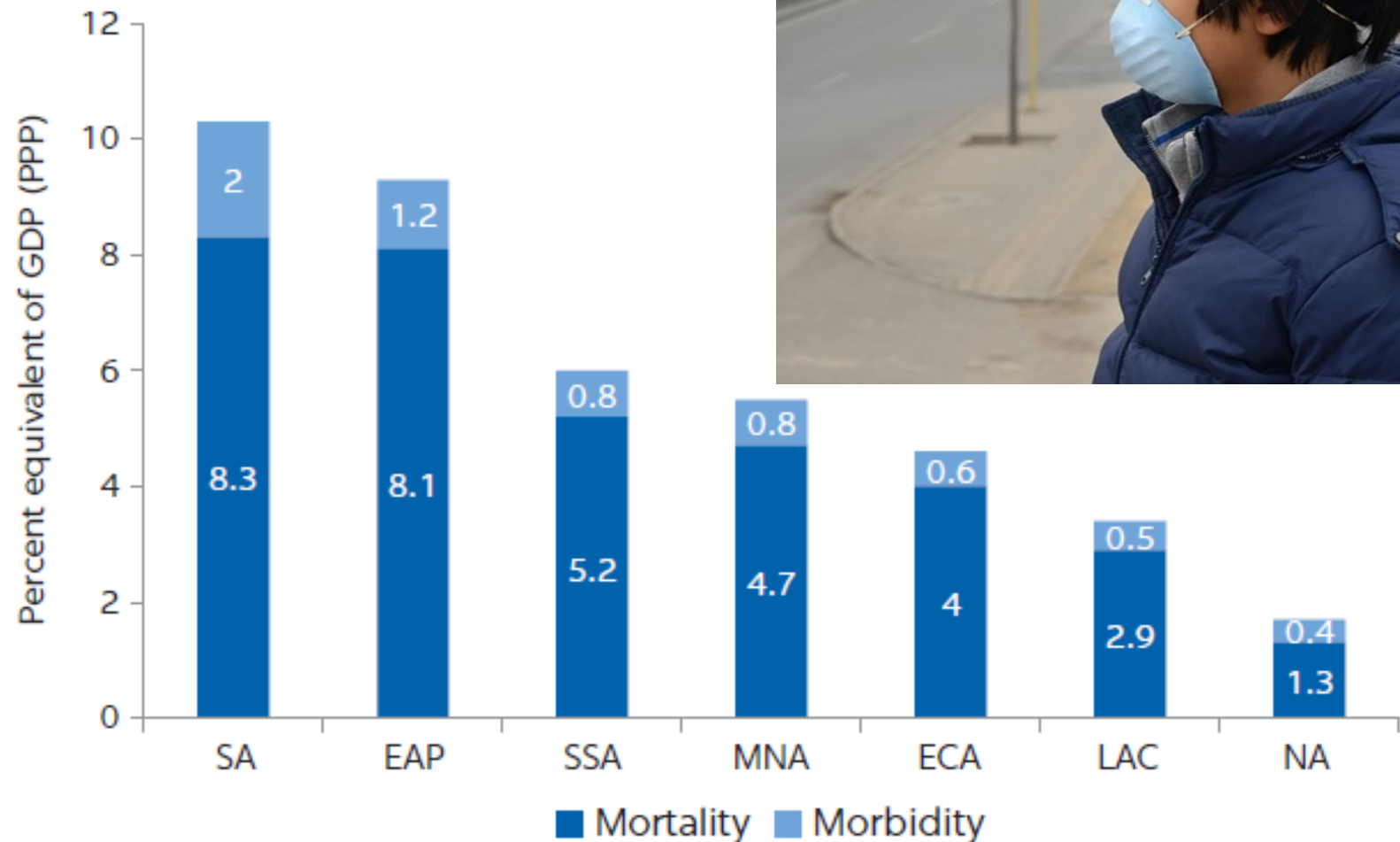
Air Pollution (PM2.5)

7.3 billion people exposed to unsafe levels (i.e. average concentration above $5\mu\text{g}/\text{m}^3$).

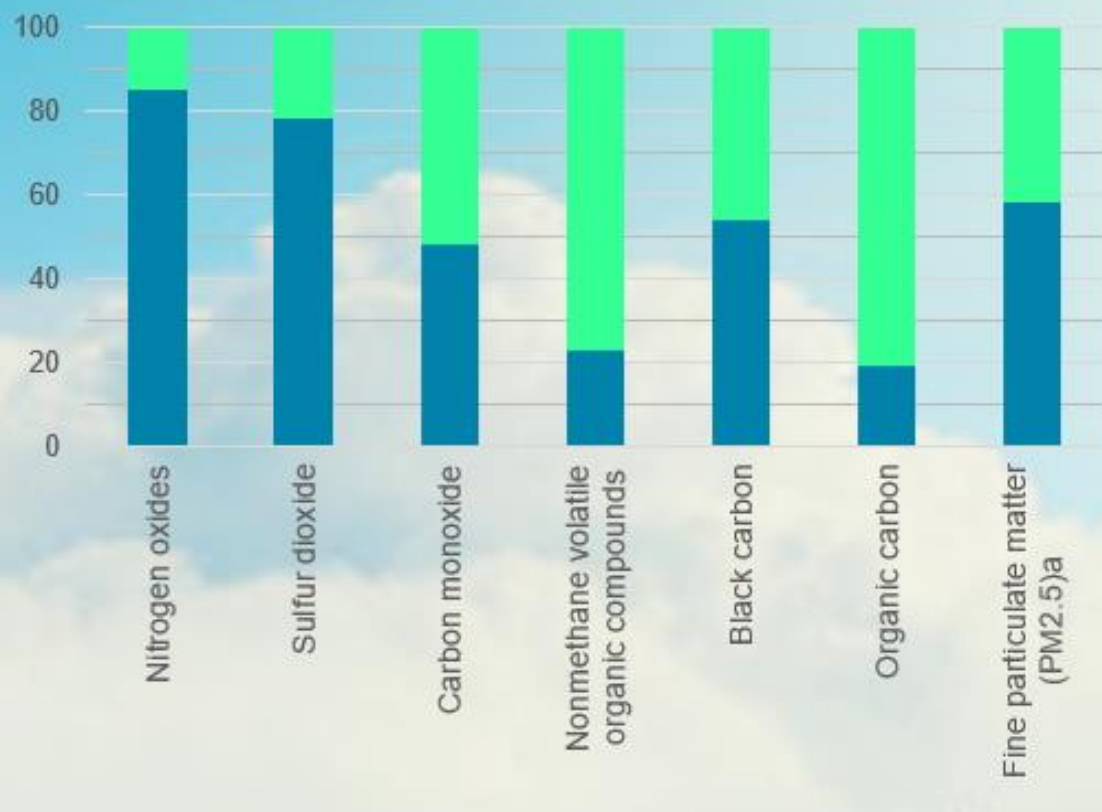
2.8 billion people exposed to “hazardous” levels (over $35\mu\text{g}/\text{m}^3$):
leading to a 24% higher mortality risk.

US\$8.1 trillion (equivalent to 6.1% of global GDP (PPP)):
the cost of mortality and morbidity caused by exposure to PM2.5 (2019).

Accounting for about **7 million premature deaths each year**, air pollution is one of the leading causes of death worldwide.



Contribution of **fossil fuels** to major air pollutants



The societal costs of air pollution

US\$5.4 trillion:

The scale of **underpricing of fossil fuel–related externalities** (implicit subsidies), according to the International Monetary Fund

US\$2.65 trillion:

The **global societal cost** associated with coal — larger than from any other fossil fuel

The burning of coal, oil, and natural gas is a leading source of ambient PM2.5 — the **pollutant responsible for the vast majority of air pollution–related deaths.**

Cadmium

Smoking, phosphate fertilizers, batteries, electronics, solar cells, plastic stabilizers, paints, pigments, and others – common household goods.



Contamination of soils and crops (Cadmium in rice and vegetables) and occupational exposure: Ingestion, inhalation.

Chronic cadmium exposure from consumption of Cd-contaminated rice in residents from the Jinzu River basin in Japan during 1955-1977.



Image: pollutionpictures.blogspot.com/2010/07/itai-itai-disease-cadmium-poisoning.html

Multiple Health Impacts

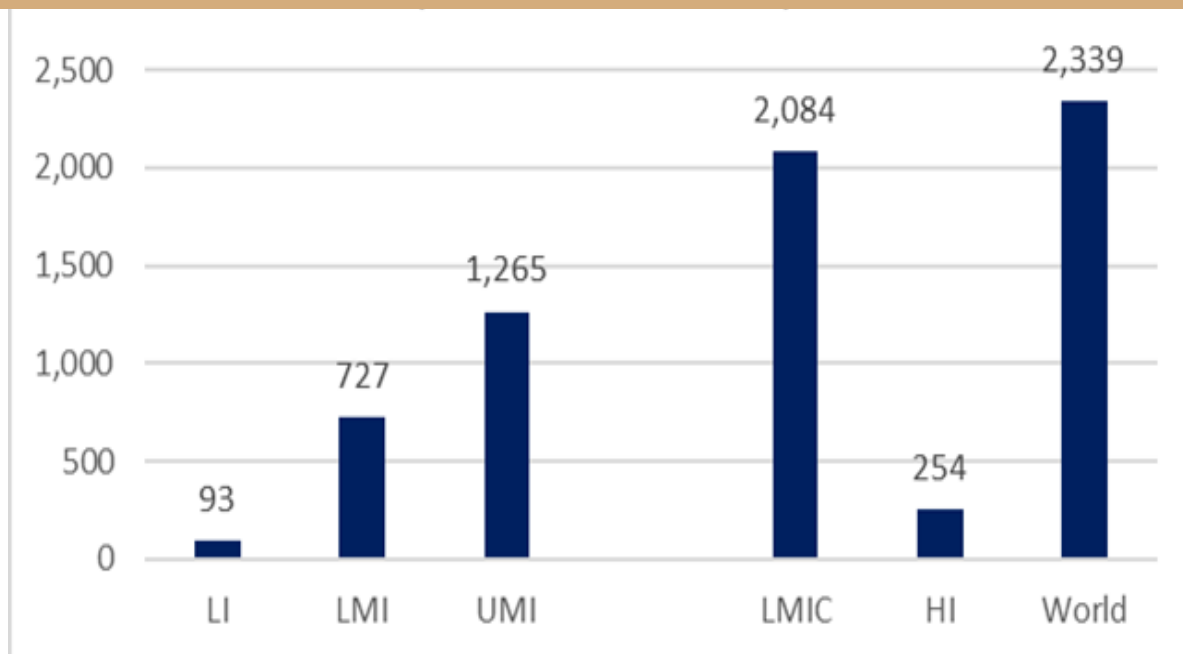
- Itai-itai disease (softening of bones)
- Kidney and liver failure (from Cd accumulation)
- Cardiovascular disease (CVD), hypertension
- Cancer – lung, kidney
- Development problems in children

CVD mortality from Cadmium exposure has a global welfare cost of between I\$2.8-5.0 trillion

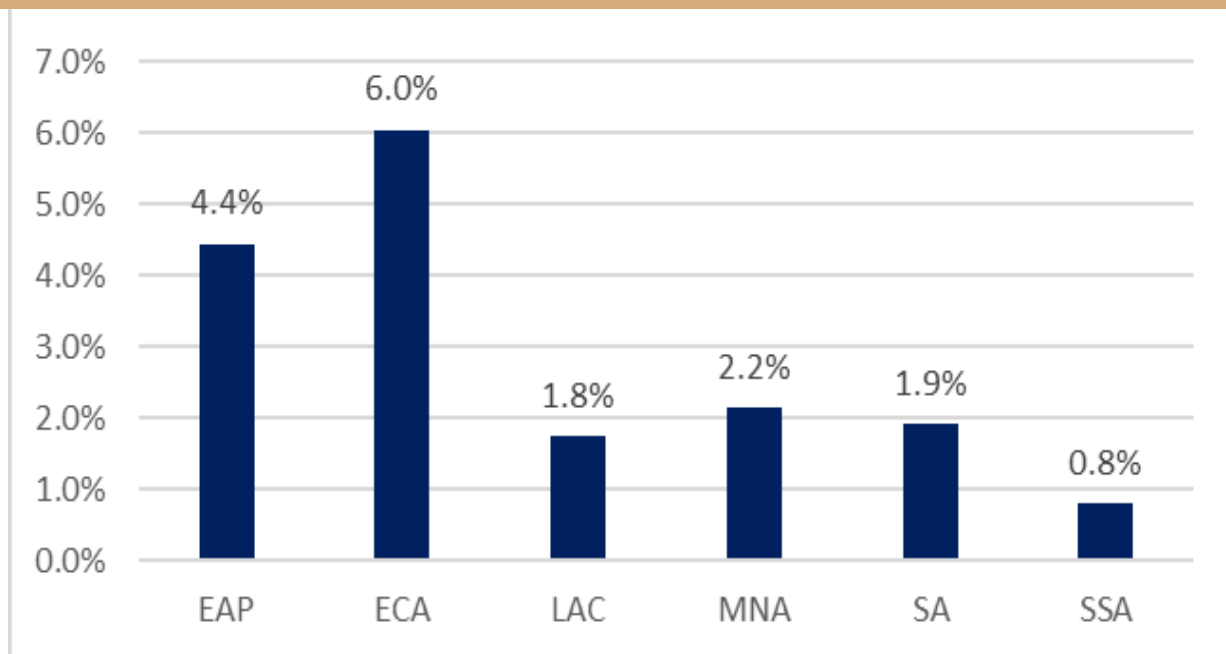
1.8 – 3.1 million (central estimate 2.3 million) death in 2019 (10-17% of global CVD mortality).

1.6 – 2.7 million deaths were in LMICs.

CVD deaths from Cadmium exposure (thousands)
(central estimate)



Cost in LMICs by Region (% GDP (PPP))
(central estimate)



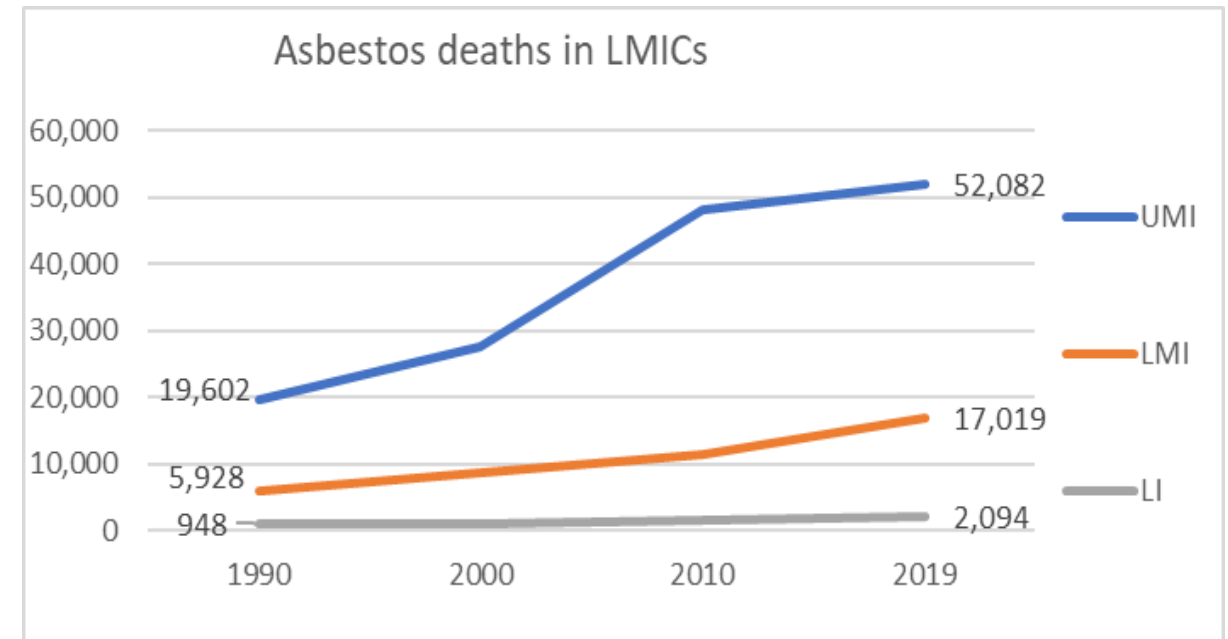
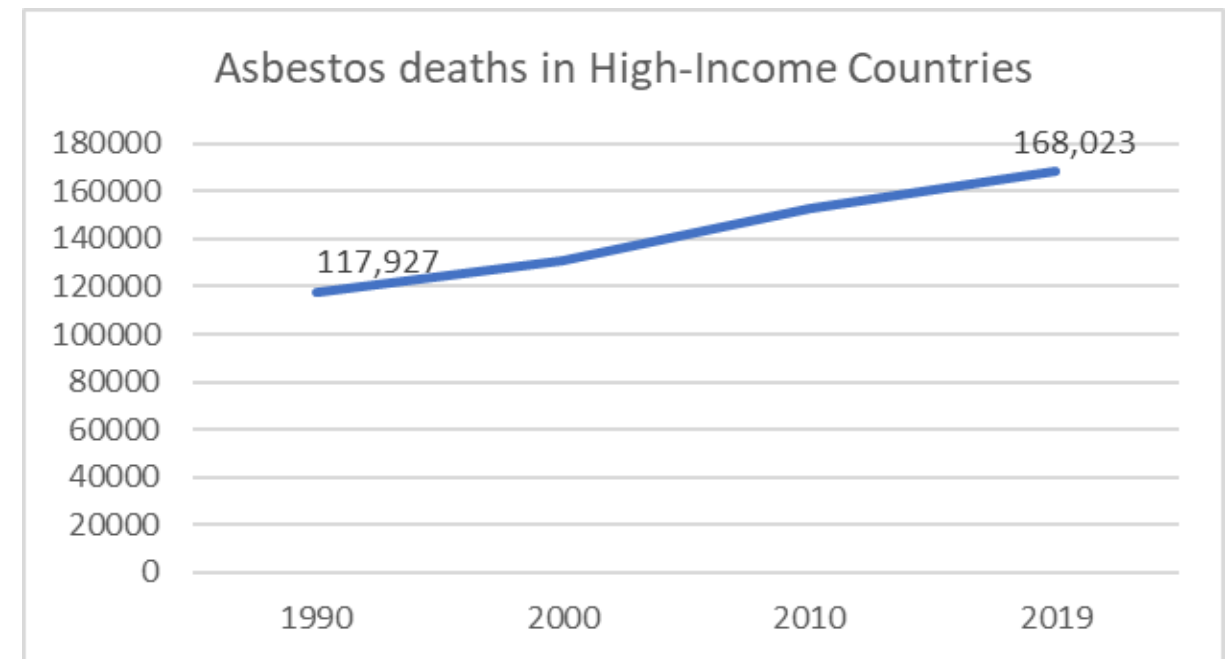
New World Bank estimates (preliminary).

Asbestos – a costly legacy

- Insulation materials, construction, industrial and consumer goods.
- Legacy of asbestos in buildings.
- Banned in high income countries.
- Use is declining in most countries.
- Increasing in India, Sri Lanka, Indonesia (2009-2021).



- Asbestosis, mesothelioma, lung cancer, in particular from occupational exposure.
- Mortality (2019) in HICs was 168,000, higher than in LMICs (71,000) due to a long lag effect (GBD 2019).
- Between 1990 and 2019, mortality increased 40% in HICs and 170% in LMICs (GBD 2019).
- By 2050, mortality can be expected to increase to 500,000 in LMICs.



Conclusions

Measure what needs to be managed

- Can there be a global metric for chemical pollution?

Precautionary principle

- Look for health impacts at presumed “safe levels”.
- “Clean up later” produces dangerous path dependencies and lagged impacts. Don’t lock in bad choices.

Policy framework

- Raise awareness to change behavior ... and demand.
- Set environmental and safety standards.
- Build capacity in LMICs: skills, equipment, institutions, enforcement.
- Make polluters pay, financiers liable, ... and don’t subsidized “the bad”.
- Invest in circular economy, benign chemistry, technology to measure and monitor, ... and cleanup projects and health where needed.

