POLLUTION AND HEALTH METRICS

Global, Regional, and Country Analysis
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GAHP
GLOBAL ALLIANCE ON HEALTH AND POLLUTION

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Cover photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

EXECUTIVE SUMMARY

Pollution is an enormous and poorly addressed health problem. In October 2017, *The Lancet* Commission on pollution and health quantified the human toll of worldwide pollution—9 million premature deaths a year.[1] The data for that analysis was from 2015. This report updates those results with the most recent dataset—2017—and also breaks down the results by country, enabling us to rank the best and worst performers in each region.

The new data shows pollution still to be the largest environmental cause of premature death on the planet, killing 8.3 million people in 2017,[2] or nearly one death in seven. These deaths are caused by exposure to toxic air, water, soil, and chemical pollution globally. The results are still conservative, as many known toxins are not included in the analysis.[1] This report draws its data from the Institute for Health Metric's (IHME's) 2017 Global Burden of Disease Study.[2]

The reductions in death from 2015 to 2017 mostly reflect changes in calculations of methodology related to air pollution. New analyses, conducted by IHME's air pollution experts, Health Effects Institute,[3] reviewed the overlap between indoor air and outdoor air with new data and methodologies. Changes were also made in methodologies for various occupational pollutants and for lead. Each of these updated the IHME calculations.

Overall, the results show an improvement in the number of premature deaths from traditional types of pollution—sanitation and household air contaminated by smoke from cook stoves—from 2015 to 2017. But premature deaths from modern pollution, those types of pollution caused by industrialization and urbanization, are on the rise. Modern pollution, now responsible for 5.3 million deaths a year, is poorly addressed in development agendas and still lacks substantive focus within international agencies, though attention to the problem is growing.

The Lancet Commission Report was principally organized around global-level data; national level results were not published. In order to respond to the interest of national governments, local researchers, and the broad public, this report presents a deeper analysis of the data available to the Commission and sets out regional and country-level overviews of pollution's heavy toll on health.

The analysis finds that those 8.3 million premature deaths are spread unevenly amongst the countries of the world. In fact, the top 10 countries most affected are responsible for two thirds of those deaths.

It should be noted that these numbers are rough estimates, with a large degree of uncertainty. The IHME data provides a range from 7 million to 10 million total premature deaths, attributing 5 million of those to air pollution. Other analyses attribute more deaths to air pollution alone—7 million according to WHO[4] and 9 million deaths according to a recent European study.[5] We use the IHME data in this report as it gives a stable basis for country comparisons and changes over time. We have not taken into account overlaps in pollution risk factors in this analysis.

TOP TEN COUNTRIES
TOTAL ANNUAL PREMATURE POLLUTION-RELATED DEATHS

Premature Pollution-related Deaths Per Year[12]

1	INDIA	2,326,771
2	CHINA	1,865,566
3	NIGERIA	279,318
4	INDONESIA	232,974
5	PAKISTAN	223,836
6	BANGLADESH	207,922
7	UNITED STATES OF AMERICA	196,930
8	RUSSIAN FEDERATION	118,687
9	ETHIOPIA	110,787
10	BRAZIL	109,438

Tragic as it is, it is not surprising to see India and China at the top of this list. They both have billion-plus populations and are industrializing rapidly. Other heavily populated countries—such as Pakistan, Bangladesh and Indonesia—are also badly affected. The United States, the world's third most populous country with 325 million people, makes the top 10 list by virtue of its size, while ranking 132nd in the number of deaths per 100,000 people. In the U.S., air pollution is responsible for more than half of the pollution-related premature deaths.

Photo: Larry C. Price/Pulitzer Center on Crisis Reporting

TOP TEN COUNTRIES

HIGHEST RATES OF DEATH ATTRIBUTED TO POLLUTION

Pollution-related Deaths per 100,000 Population[12]

1	CHAD	287
2	CENTRAL AFRICAN REPUBLIC	251
3	NORTH KOREA	202
4	NIGER	192
5	MADAGASCAR	183
6	PAPUA NEW GUINEA	183
7	SOUTH SUDAN	180
8	SOMALIA	179
9	SERBIA	175
10	INDIA	174


Photo: Pure Earth

Pollution is a leading cause of premature death in many smaller low- and middle-income countries where the death rates per 100,000 people are much higher than those in more populous, high-income nations. Poor water sanitation and contaminated indoor air are major killers in the world's poorest nations. India, the second most populous nation, appears on both Top Ten lists with not only the highest number of deaths but also the 10th highest death rate. India has seen increasing industrial and vehicular pollution from urban growth while poor sanitation and contaminated indoor air persist in low-income communities.

Five nations on the Arabian Peninsula rank among the 10 countries in the world with the lowest death rates from pollution, with Qatar reporting the lowest death rate among the countries surveyed. Wealthier nations, by and large, have lower death rates from pollution, though pollution death rates in India and China far exceed those of other high-GDP nations. Among the ten nations with the highest GDP, Canada has the lowest death rate from pollution, followed by Brazil.

TOP TEN COUNTRIES

TOTAL ANNUAL PREMATURE AIR POLLUTION-RELATED DEATHS

Air Pollution

Much of the world's attention is focused on ambient air pollution, especially the smog that often envelops Beijing and Delhi. There is a reason for this: **Ambient air pollution and ozone are responsible for 40 percent of all pollution-related deaths or an estimated 3.4 million deaths a year**. Add in the tally from indoor air pollution and the count grows to almost 5 million premature deaths caused by breathing bad air. Half of all air pollution-related deaths occur in Chinese and Indian cities.

Total Annual Premature Air Pollution-Related Deaths[12]

1	CHINA	1,242,987
2	INDIA	1,240,529
3	PAKISTAN	128,005
4	INDONESIA	123,753
5	BANGLADESH	122,734
6	NIGERIA	114,115
7	UNITED STATES OF AMERICA	107,507
8	RUSSIAN FEDERATION	99,392
9	BRAZIL	66,245
10	PHILIPPINES	64,386

Photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

I. POLLUTION AND ITS IMPACTS RECOGNIZED

Pollution is still the world's largest environmental threat to health, responsible in 2017 for an estimated 8.3 million premature deaths, or 15% of all deaths globally, and 275 million Disability-Adjusted Life Years.[2]

Pollution kills three times as many people a year as HIV/AIDS, tuberculosis, and malaria combined.[12] Pollution is responsible for 15 times the number of deaths caused by war and other forms of violence each year.[1] In the most severely affected countries, diseases associated with pollution account for more than one death in four.[2] And yet our understanding of its true magnitude—its devastating relationship to human and planetary health; its immense drain on national budgets; its sheer volume—remains limited, occluded by vested interests and overtaxed political infrastructures, and lost among the compartmentalized foci of individual ministries and government agencies.

An awareness that approximately one in seven deaths in the world is pollution-related[2] should in itself be an immediate call to arms for civil society and government actors alike. Actions to mitigate pollution and implement solutions should be urgently undertaken. However, despite pollution's substantial effects on human health (as well as on the economy and the environment), pollution mitigation remains in large part neglected, especially in low- and middle-income countries.[13]

The *Lancet* Commission on pollution and health was formed in an effort to help incite necessary action and to amplify the message that pollution is responsible for massive numbers of deaths and even larger numbers of disabilities. The Commission, led by Dr. Philip Landrigan and Richard Fuller, was the product of a collaboration between *The Lancet*; The Global Alliance on Health and Pollution (GAHP), including independent researchers and policy makers; and the Icahn School of Medicine at Mount Sinai in New York, NY, USA.

The Commission analyzed data from Pure Earth, the World Health Organization (WHO), and the Institute for Health Metrics and Evaluation's (IHME) Global Burden of Disease Study. It reviewed pollution and health literature and also studied current national and international programs and conventions to date on pollution mitigation. Its findings and recommendations were published in October 2017 as *The Lancet* Global Commission on Pollution and Health Report.

The report had three major messages:

- Pollution is the largest environmental threat to health.
- Pollution has been severely neglected and has not received adequate attention at private or government levels.
- Pollution can be controlled with solutions that already exist.

Coverage of the report's launch validated the conviction of the Commissioners that the time was right for a global awakening to the pollution problem. Within only a few days of the launch, media hits on reporting of the key messages calculated a reach of over 2 billion people.

The Lancet Commission Report was principally organized around global-level data, with some regional and/or country-level breakdowns. The present report delves deeper into the data to present regional and country-level overviews of pollution's heavy toll on disease.

UNDERSTANDING THE POLLUTION RISK FACTORS

The pollution risk factor categories in our analysis (air, water, occupational, and lead) are the same as those from *The Lancet* Commission Report. With the exception of lead, each category has multiple pollution types. Data for "air pollution" represents a combination of household air pollution, outdoor air pollution, and ozone. "Water pollution" represents a combination of unsafe water source and unsafe sanitation (both capturing deaths primarily from pathogens). "Occupational risk" encompasses numbers of deaths from occupational carcinogens, second-hand smoke, particulates, gases, and fumes. Lead pollution deaths account only for deaths associated with exposure to legacy emissions from leaded gasoline (the lead that was deposited, and still remains, in the soil from car exhaust).

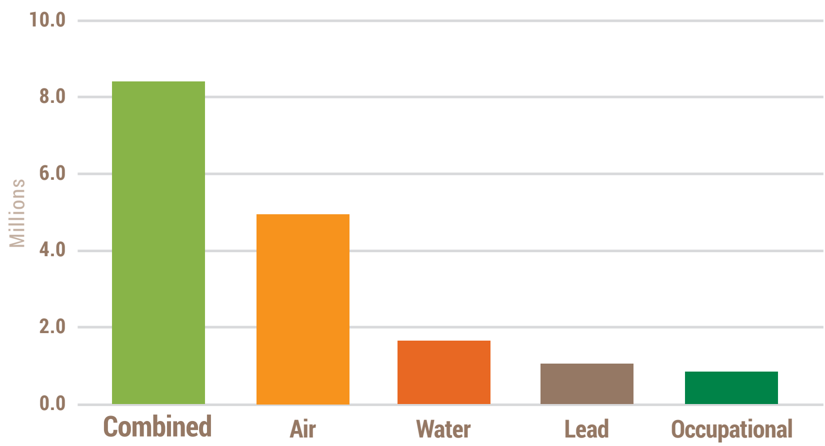
As previously discussed, the pollution categories capture limited types of exposure. It is important to be aware of this when making country-level comparisons. For example, deaths from water pollution do not include deaths from exposure to industrial chemicals. Occupational pollution largely excludes informal sector work, which is especially important in low- and middle-income countries (LMICs). Deaths from exposure to lead pollution from sources other than leaded gasoline (such as from informal used lead-acid battery recycling, lead glazes in pottery, lead in paint, etc.) are not captured in the data.

The Figures are Still an Underestimate

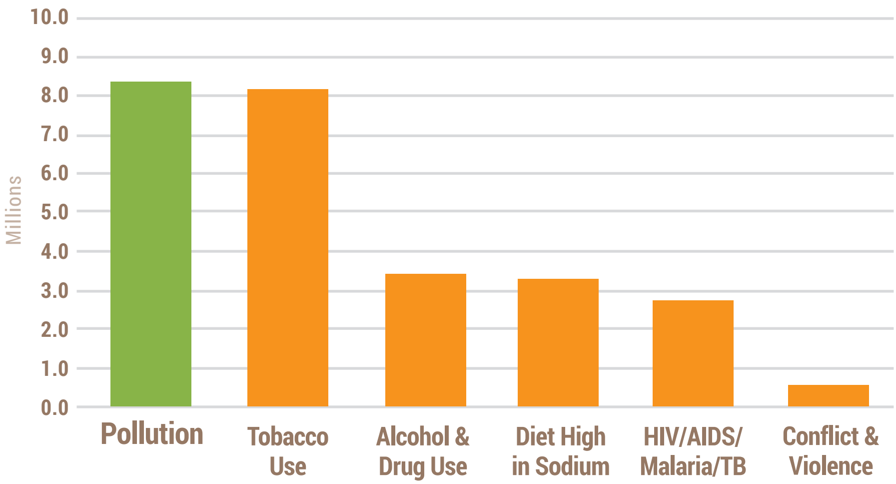
The number of deaths and, ultimately, the death rate from pollution are most likely stark underestimates of the true toll.

Among the pollution risk factors, air pollution is responsible for the greatest disease burden. This is not a surprise given the attention that smog and air pollution have been receiving in the global media and the breadth of research available in relation to other types of pollution. It is conjectured, however, that numbers in the other pollution risk categories will rise as the magnitude and scope of pollution is further quantified and as researchers continue to discover new associations between pollution and disease.

Total Deaths from Individual Pollution Risk Factors[12]



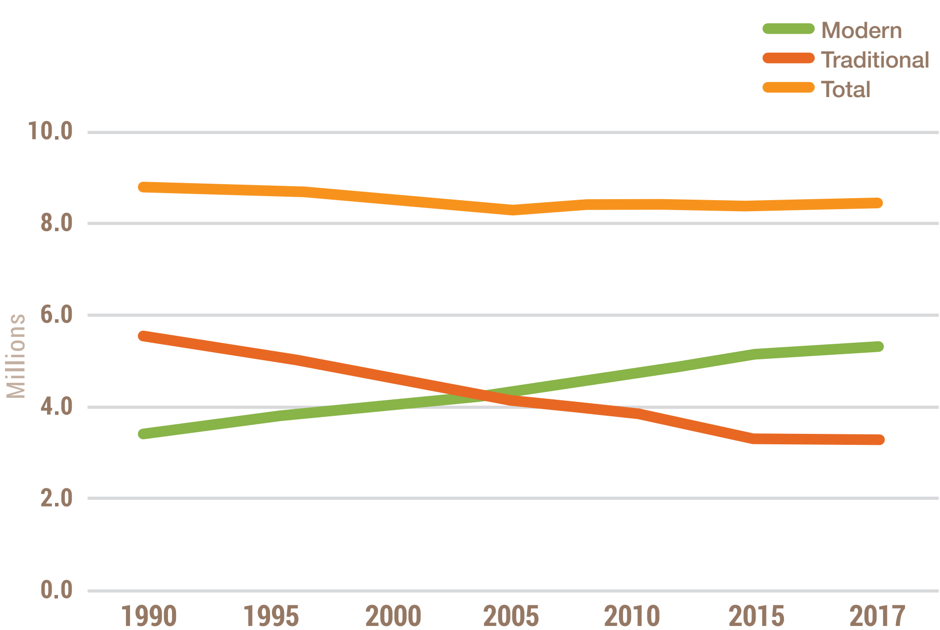
Global Number of Deaths by Risk Factor[12]



MODERN VS. TRADITIONAL POLLUTION

Pollution can be categorized as modern and traditional. **Modern pollution results from industrialization and urbanization and includes ambient air pollution, soil and chemicals pollution, and pollution in the workplace**. These forms of pollution are increasing. Traditional pollution refers to indoor air pollution, largely caused by poor ventilation and smoke from cook stoves and heating fires, and water pollution from unsafe sanitation. Traditional pollution, which closely correlates with poverty, improves as economies grow and living standards rise.[1]

Modern Versus Traditional Pollution Over Time[12]



INFORMAL SECTOR

The informal sector or "informal economy" encompasses economic activities that are not covered by formal employment arrangements. In many low- and middle-income countries (LMIC), the informal economy constitutes a substantial and important portion of the labor force. For example, almost 70 percent of the workforce in the Asia-Pacific region perform jobs in the informal economy.[6]

Although it is difficult to generalize about the quality and nature of informal economy work, some sectors, such as mining and used lead-acid battery and e-waste recycling, are known for their dangerous working conditions, lack of worker protections, and environmental pollution. Informal sector work is not government regulated and, therefore, is often insufficiently tracked and monitored. This greatly restricts the availability of reliable data. Occupational pollution data as presented in the global, region, and country-level summaries in this report does not include the informal sector.

To date, there is very little research on the global disease and disability burdens associated with the informal sector. However, research published over the past year indicates that the pollution generated from this massive economic driver, which is mostly discharged without treatment directly into the environment, is responsible for substantial human health costs.[7,8]

Used Lead-acid Battery (ULAB) Recycling

Recycled lead is a valuable commodity, and for many people in LMIC countries, recovering lead from used lead-acid batteries can be a profitable, if potentially dangerous, endeavor. Between 6 to 16 million people are believed to be exposed to dangerous levels of lead each year at informal ULAB recycling sites.[7]

A recent study by Ericson et al. conservatively estimated there are at least 29,000 small-scale, informal ULAB recycling facilities in the 90 LMIC countries reviewed. Lead exposures from these sites result in the loss of an estimated 0.87 million DALYs.[7]

Lead-acid batteries consist of a plastic case that holds lead plates covered with a lead paste and submerged in dilute sulfuric acid. The Basel Convention classifies these batteries as hazardous, requiring special precautions in handling and recycling.

However, at informal ULAB recycling sites, workers often break open the cases with hand axes or hammers and smelt the lead over open-air fires, often in crowded shopping areas or in residential backyards. Toxic emissions and dust settle into the immediate surroundings, including waterways and soil. Uncovered and unprotected battery waste leaches lead into groundwater and community waterways.[7]

Artisanal and Small-Scale Gold Mining

Artisanal and small-scale gold mining (ASGM) is among the world's largest anthropogenic sources of mercury emissions.[9] An estimated 14 to 19 million artisanal and small-scale gold miners work in more than 70 countries, with an estimated 2.9 million DALYs lost annually to elemental mercury poisoning.[8,10]

Mercury is widely used in informal, small-scale mining during processing to separate the precious metal from ore. Mercury binds to the gold, separating it from other minerals, which are washed away during processing. The remaining mercury-gold amalgam is then heated, often with a blow torch. Under intense heat, mercury evaporates, leaving behind pure gold.

Artisanal miners are often directly exposed to mercury vapors through the amalgam burning process.[10] Anywhere from 5 to 60 grams of mercury are used in the recovery of just one gram of gold.[11] Without proper disposal and containment, mercury can contaminate water sources and soil surfaces. Mercury is also known to accumulate in plants grown in contaminated soil.

	Artisanal and Small-scale Gold Mining[7]		Used Lead-Acid Batteries[6]		Total Median DALYs*
	Population exposed*	Median DALYs*	Population exposed*	Median DALYs*	
Africa	10.9	1.91	4.11	0.32	2.23
Eastern Med	0.30	0.05	1.54	0.10	0.15
Europe	2.35	0.43	1.45	0.07	0.19
Americas	0.37	0.07	5.53	0.22	0.50
Southeast Asia	0.37	0.07	3.73	0.13	0.29
Western Pacific	0.19	0.35	3.73	0.13	0.48
Total	16.70	2.96	16.80	0.87	3.83

*In millions

II. GLOBAL SCALE OF THE PROBLEM

Photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

More than 90 percent of pollution-related deaths occur in low- and middle-income countries.[1]

Diseases linked to pollution disproportionately kill the poor and vulnerable. Water pollution from unsafe sanitation and unsafe sources disproportionately afflicts lower-income countries, as does indoor air pollution from cook stove smoke.

Photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

Summary of the Global Results

Category of Identified risk	Millions of Premature Deaths Annually
AIR (Total)	4.9
Household Air	1.6
Ambient Particulate	2.9
Ozone	0.5
WATER (Total)	1.6
Unsafe Sanitation	0.8
Unsafe Source	1.2
OCCUPATIONAL (Total)	0.8
Carcinogens	0.5
Particulates	0.3
LEAD	1.0

TOTAL
8.3 million deaths annually[12]

***Note** that some totals are less than the arithmetic sum of the individual risk factors within each categories on account of overlapping contributions—e.g., household air pollution also contributes to ambient air pollution and vice versa.

NOT JUST DEATH BUT ALSO DISABILITY

The horrific global impacts of pollution are felt by populations not just as premature deaths each year, but also as impacts on health and on ability to live and enjoy a normal life. This "disability" burden is easy to understand but is more difficult to measure than actual deaths. A DALY is a summary metric of population health that combines information on mortality and disease into a single number to represent the health of a population. Specifically, it measures the overall disease burden, expressed as the number of years lost due to ill health, disability, or early death. Use of the DALY permits comparisons of disease burdens between countries, between diseases, and over time.

DALYs are based on expert medical opinion and, therefore, are subject to revision and updating. They do, however, indicate the huge scale of the suffering—often hidden—imposed on the affected populations.

Photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

PLASTICS

Plastic is the most prevalent type of debris found in our oceans and great lakes. Plastic debris can come in all shapes and sizes. Bits of plastic less than 5 millimeters in length are called microplastics. Plastics are currently gaining wide-scale news coverage as we continue to discover them in new places. Their extreme ubiquity is unprecedented, with new studies finding tiny plastic particles and fibers in our oceans, our land, in the air we breathe, and even in the food we consume.

Microplastics come from a variety of sources, including from larger plastic debris that degrades into smaller and smaller pieces and from tiny pieces of manufactured plastic added to health and beauty products for their exfoliating properties. Plastic microfibers shed in the thousands from synthetic fabrics with each wash. Too small to be captured in most water treatment facilities, tens of thousands of pounds of microfibers enter into open water systems every day in the United States alone. Microfibers are also released by the thousands from eroding vehicle tires.

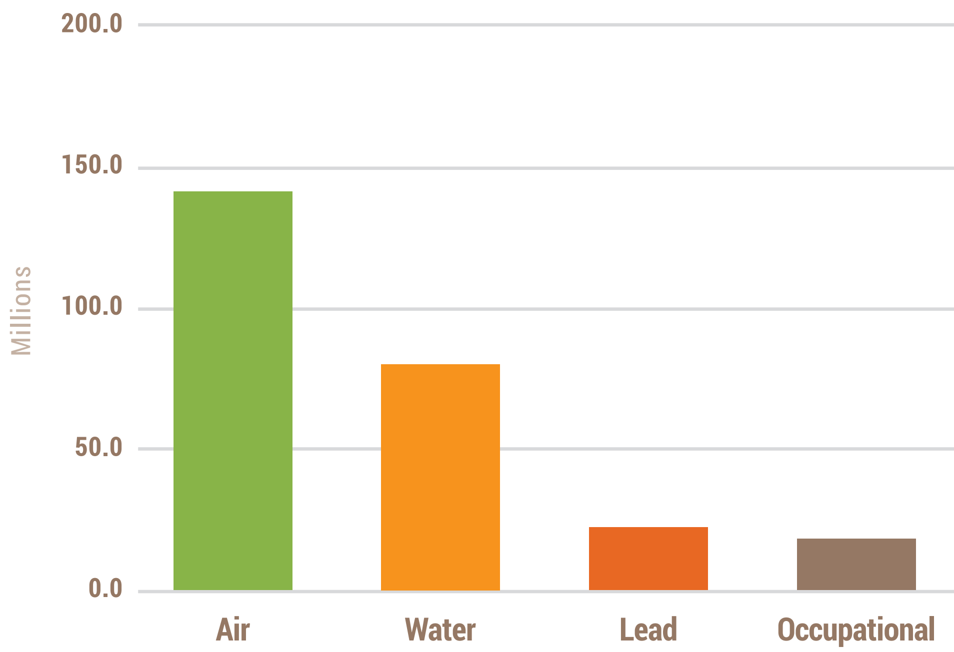
There is little research on the direct health effects of plastics on humans; however, scientists are growing increasingly concerned about their sheer scope and the contact humans have with them. Plastics often contain a wide range of known toxic chemicals. Other pollutants, such as dioxins, metals, and pesticides can cling to plastic surfaces. Concern also is growing about the health effects of ingested and inhaled microplastics. Scientists worry about the potential for inhaled microplastics to lodge in the lungs or enter the bloodstream, as do very small particulates in air pollution.[29]

Global Disability-Adjusted Life Years (DALYs) Attributable to Pollution

It is estimated that **approximately 275 million DALYs are attributable to pollution globally**. To further understand the extent of these DALYs in relation to specific risk factors, the DALYs can be presented according to specific pollution risk factor categories such as air, water, occupational, and lead.

As we can see in the chart below, air pollution is responsible for roughly 147 million DALYS, more DALYS than water (84 million), lead (24 million), and occupational pollution (18 million) combined.

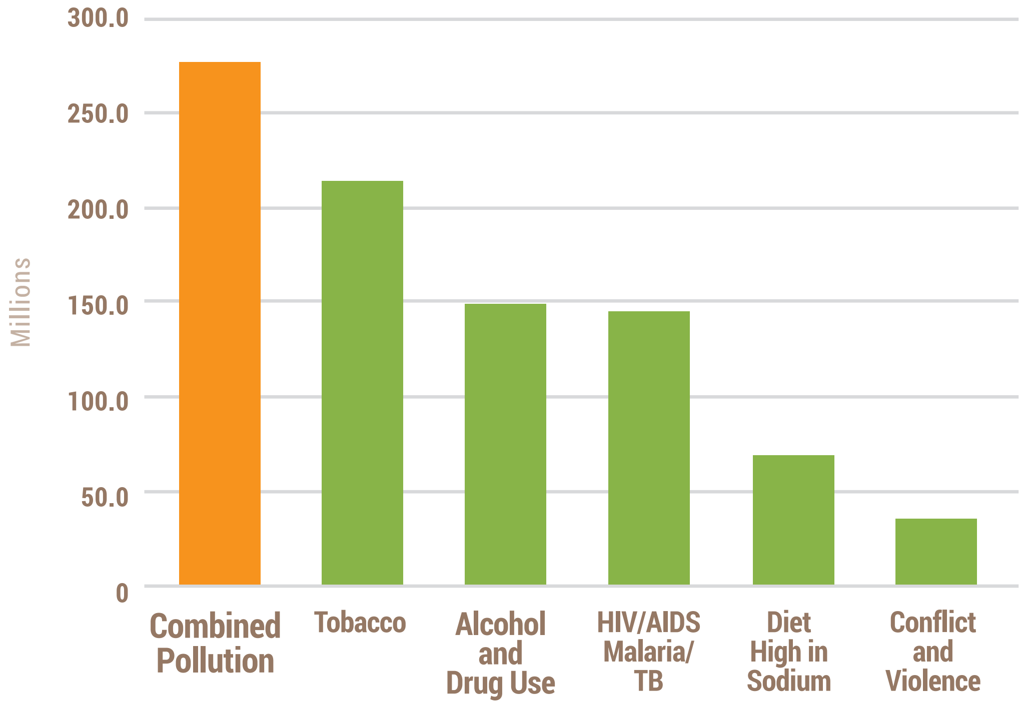
DALYs Attributable to Pollution Risk Factors[12]



Global Disability-Adjusted Life Years (DALYs) Attributable to Risk Factors and Causes

The global number of DALYs from all forms of pollution is several times greater than DALYs from other risks and causes, such as a diet high in sodium, alcohol use, and conflict and violence.

DALYs Attributable to Other Risk Factors and Causes vs. Pollution[12]



CLIMATE CHANGE

It is generally accepted that climate change will have clear, direct impacts on human health, such as physical injuries and death caused by flooding and extreme weather events, water-borne illnesses worsened by a lack of clean water due to drought, and increased heat-related morbidity and mortality. However, climate change will also have cascading impacts on other systems with far-reaching impacts on humans. In particular, the relationship between climate change and pollution could vastly increase the number of people who come into contact with pollution. This could result in significantly greater pollution-related disease and death.[14]

As a primary example, climate change's effects on the water cycle will most certainly alter how we come in contact with pollution. It is expected that some regions will experience both a greater frequency and intensity of heavy rainfall events and more profound and longer-lasting droughts.[15] This fluctuation between extremes can increase the potential for pollutants to mobilize and enter our air and water. Drought degrades soil structure, causing increased cracks in soil and reducing its capacity to hold water.[15] Thus, when drought is followed by heavy rainfall, the ground absorbs less water, sending runoff and any contaminants it may contain into areas previously untouched by pollutants.[16,17]

In addition, drought leads to water evaporation. When a contaminated water source loses water, the concentration of toxins intensifies, worsening the quality of the remaining water. Communities that rely on these bodies of water as drinking sources will ingest more toxins with every sip.[17] As water sources become scarce, people will increasingly be forced to choose between using risky water supplies, going without water, or purchasing more expensive bottled water.[18]

Increased rainfall and rising sea levels are expected to change flood patterns in significant ways. In many cases, toxic waste facilities, dumps, mine tailings, agricultural sewage ponds, and other sites that may have been considered safe from flooding are now being forced to re-evaluate flood risk potential. Floodwaters overtaking these sites can take up contaminants and deposit them miles away. Floodwater also damages infrastructure, such as water treatment plants designed to withstand past climatic conditions rather than the more severe weather anticipated from climate change. This damage to critical infrastructure may result in the discharge of chemicals and raw sewage directly into rivers, lakes, and drinking water supplies.[19,20]

Climate change-induced higher temperatures may also magnify the risk of exposure to toxins. Metals become more volatile with higher temperatures, meaning that they are more easily released from soil into air, which increases the chances for dispersal by the wind.[14] Higher temperatures, coupled with drought, increase the potential for wildfires, which are known to release legacy toxins (including lead from gasoline) that have been sequestered in forest soil and plants into the atmosphere.[21,22] Higher temperatures may also alter the chemical structure of some contaminants (including mercury, copper, and lead), potentially making them more dangerous.[14,23] The acidification of the ocean that we are seeing as a result of higher temperatures may also enable contaminants to enter cellular structures.[24]

Importantly, high temperatures and wetter climates are linked to proliferations of pests and diseases in agriculture, which often lead to more frequent and heavy applications of pesticides and fertilizers.[25,26] In addition to pesticides' endocrine-disrupting potential and probable linkages to cancer, agricultural runoff is the major contributing factor to "dead zones" in oceans.[25,27] Reduced plant diversity can have serious consequences for both the environment and human health, as biodiversity plays a role in limiting environmental impacts on other systems, including removing pollutants from the environment.[28]

We are only just beginning to understand the complex relationship between pollution, health, and climate change; however, preliminary studies suggest that climate change will indeed amplify the risk of toxic exposures. It is critical that potential toxic exposure be taken into account as part of any comprehensive climate change action plan.

III. REGIONAL AND COUNTRY-LEVEL IMPACTS OF POLLUTION

Photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

Photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

For a better understanding of how pollution varies across different countries and impacts different parts of the world, the data underlying the global figures has been reexamined and more detailed figures produced for countries across the world, presented here using WHO regions as a framework. The number of total deaths from combined pollution risk factors, as well as pollution death rates, are calculated for each country.

The death rates are based on the number of deaths from pollution risk factors per 100,000 people within the country or region. The death rate is not a proportion and, therefore, does not calculate pollution-related deaths relative to other deaths.

Pollution is a cross-cutting issue that is profoundly intertwined with sustainable development and economics. It is difficult to achieve higher rates of education when children suffer from diminished IQs resulting from exposure to toxic chemicals; it is difficult to convince people to mitigate pollution when they have not been schooled on pollution's devastating effects. Demanding the right to a healthy environment is easier in regions where there is peace and justice. Ending hunger is contingent on the availability of clean soil and water. Lifestyles must evolve towards a more circular economy of responsible consumption in order to avoid unnecessary waste. Extreme poverty must be eliminated to give people options on where they live and how they work. In studying the graphs and charts that follow, the correlation between relative wealth of a country and burdens of pollution and associated diseases cannot be denied.

Photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

REGIONAL RESULTS

The regional analyses presented in this report are structured on the basis of WHO's operating regions: Africa, the Americas, Eastern Mediterranean, Southeast Asia (including India and other South Asian countries), and Western Pacific (including China).

Predictably, Southeast Asia and Western Pacific are the regions most affected by pollution deaths, principally due to the situations in India and China, respectively.

Africa also suffers from a high incidence of DALYs from pollution, exceeded in this respect only by Southeast Asia. This is also a region in which infant mortality from unsafe sanitation continues to be a major issue.

More than two-thirds of the adverse health impacts of pollution are experienced as non-communicable diseases (NCDs). Pollution of all types was responsible for 17% of all deaths from cardiovascular disease, 21% of deaths from ischemic heart disease, 16% of deaths from stroke, 56% of deaths from chronic obstructive pulmonary disease, and 33% of deaths from lung cancer.

Much of the attention generated by *The Lancet* report in 2017 was understandably focused on deaths and ambient air pollution. It should be noted here that premature deaths from other sources such as exposure to soil and chemicals pollution are severely undercounted. Because of gaps in the data and an absence of research, deaths formally attributable to soil and chemicals pollution currently include only one specific case: exposure to background residual lead particles, which were deposited in the soil while leaded gasoline was in use and remain there today. The much larger exposure to lead from informal battery recycling, foodstuffs, and lead in pottery and paint does not as yet feature in the Global Burden of Disease pollution-health research,[1] and many other chemical-related issues are not even mentioned at present. There is need to include these many unconsidered sources and to make better estimates of the impacts and costs of non-fatal pollution-related illnesses and disability, typically estimated as DALYs.

Indeed, disability short of death may be a consequence of pollution that is just as alarming as mortality. Exposure at a young age to lead, a neurodevelopmental toxicant, can result in lifelong intellectual impairment. Given the lack of inclusion of lead exposures from ULAB recycling, paint, pottery, and sources other than leaded gasoline, and exposures to other heavy metals and chemicals, the current estimate of 275 million pollution-related DALYs worldwide is likely a major undercount.

WHO REGIONS

- African Region
- Region of the Americas
- Southeast Asia Region
- European Region
- Eastern Mediterranean Region
- Western Pacific Region

Credit: World Health Organization

WHO divides its global operations into six regions:

Americas
All countries in North, Central, and South America.

Africa
All African countries, except Morocco, Tunisia, Libya, Egypt, Sudan and Somalia, which are in the Eastern Mediterranean region.

Europe
All European countries.

Eastern Mediterranean
Countries of the Middle East, Afghanistan, Pakistan, and the aforementioned northeastern African nations.

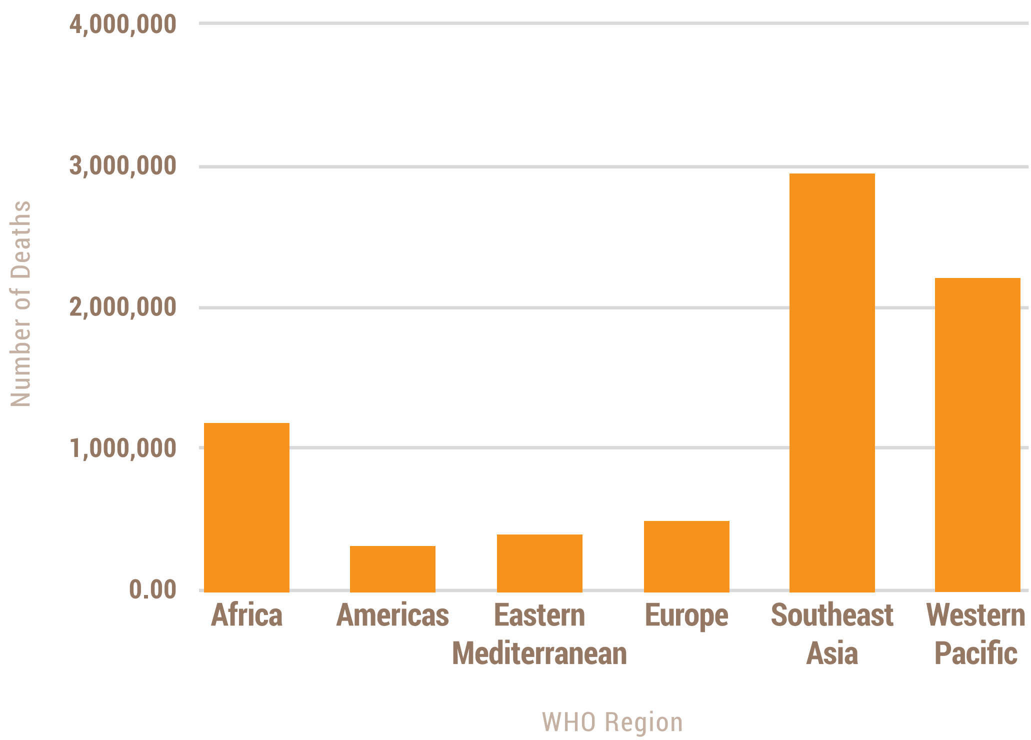
Southeast Asia
All countries in South Asia, except Afghanistan and Pakistan; North Korea; and Southeast Asia, except Cambodia, Laos, Malaysia, the Philippines, and Vietnam, which fall under Western Pacific.

Western Pacific
China, Mongolia, South Korea, Papua New Guinea, Australia, New Zealand, and the aforementioned Southeast Asian countries.

Death Toll from All Pollution Risk Factors

By WHO Region

Deaths from Combined Pollution Risk Factors by WHO Region[12]



As much as 62% of global pollution-related deaths occur in two regions—Southeast Asia and Western Pacific—reflecting the situation in India and China, respectively. There is also a wide variation across regions in the composition of deaths by pollution risk factor.

Africa

Traditional pollution causes more deaths and disabilities than modern pollution. Water pollution (especially unsafe sources) is the main issue, but air pollution (especially indoor) is also a problem.

Americas

Modern pollution is the predominant challenge, with ambient air pollution causing the greatest harm, followed by occupational and lead pollution.

Eastern Mediterranean

Both traditional and modern pollution pose challenges, with ambient air pollution the main problem, followed by water (unsafe sources).

Southeast Asia

Both traditional and modern pollution are issues, with ambient and indoor air pollution (55% of total deaths) the main problems, followed by water pollution (especially unsafe sources), occupational, and lead pollution.

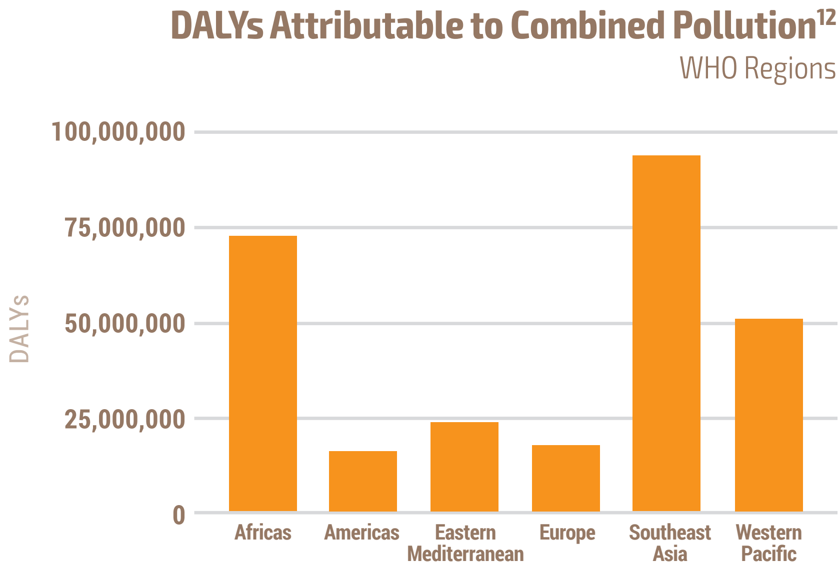
Western Pacific

Modern pollution predominates, with ambient air the principal issue, followed by occupational pollution.

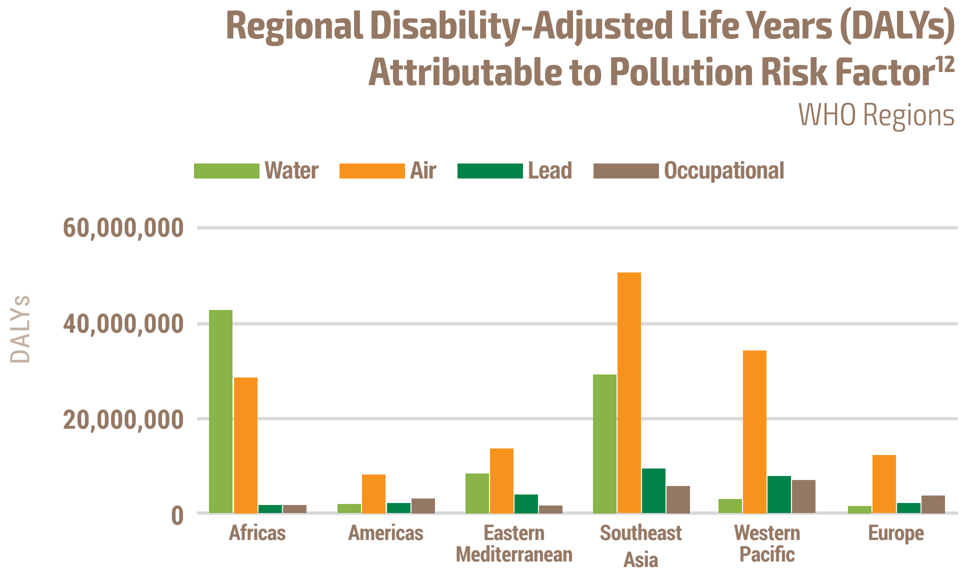
Europe

Modern pollution is the primary concern, with ambient air pollution foremost, followed by occupational and lead pollution.

Regional Disability-Adjusted Life Years (DALYs) Attributable to Pollution



Regional Disability-Adjusted Life Years (DALYs) Attributable to Pollution Risk Factor



Southeast Asia's high population numbers, combined with high levels of pollution, notably in air and water/sanitation, result in large numbers of pollution-related disease and disability in the region.

PHARMACEUTICAL WASTES

Thousands of tons of pharmaceutical wastes are discharged into the environment each year, and measurable levels of multiple drugs, including anti-inflammatory agents, antibiotics, estrogens, anti-epileptics, and cancer chemotherapy agents are detected in urban wastewater.[30–32] There is increasing fear that these compounds may damage fresh and saltwater marine species through a range of toxicological mechanisms, including endocrine disruption.[33]

Concern about antibiotic waste and the potential development and spread of antimicrobial resistant strains of bacteria has also been raising alarms. It is believed that antimicrobial resistance is primarily caused by inappropriate use and overuse of antibiotics in humans and animals (often administered in feedlots).[33] However, increasing evidence[34] is linking antimicrobial resistance to pharmaceutical waste in water supplies, whether from human excreta, industrial effluent, or expired medications washed down household plumbing.

A recent letter published in *The Lancet* Infectious Diseases cited 700,000 annual deaths globally from drug-resistant strains of common bacterial infections. Without comprehensive interventions to curtail the antibiotic use and inappropriate industrial and personal disposal methods, the number of deaths from drug-resistant bacteria could rise to an estimated10 million per year by 2050.[34]

AFRICA

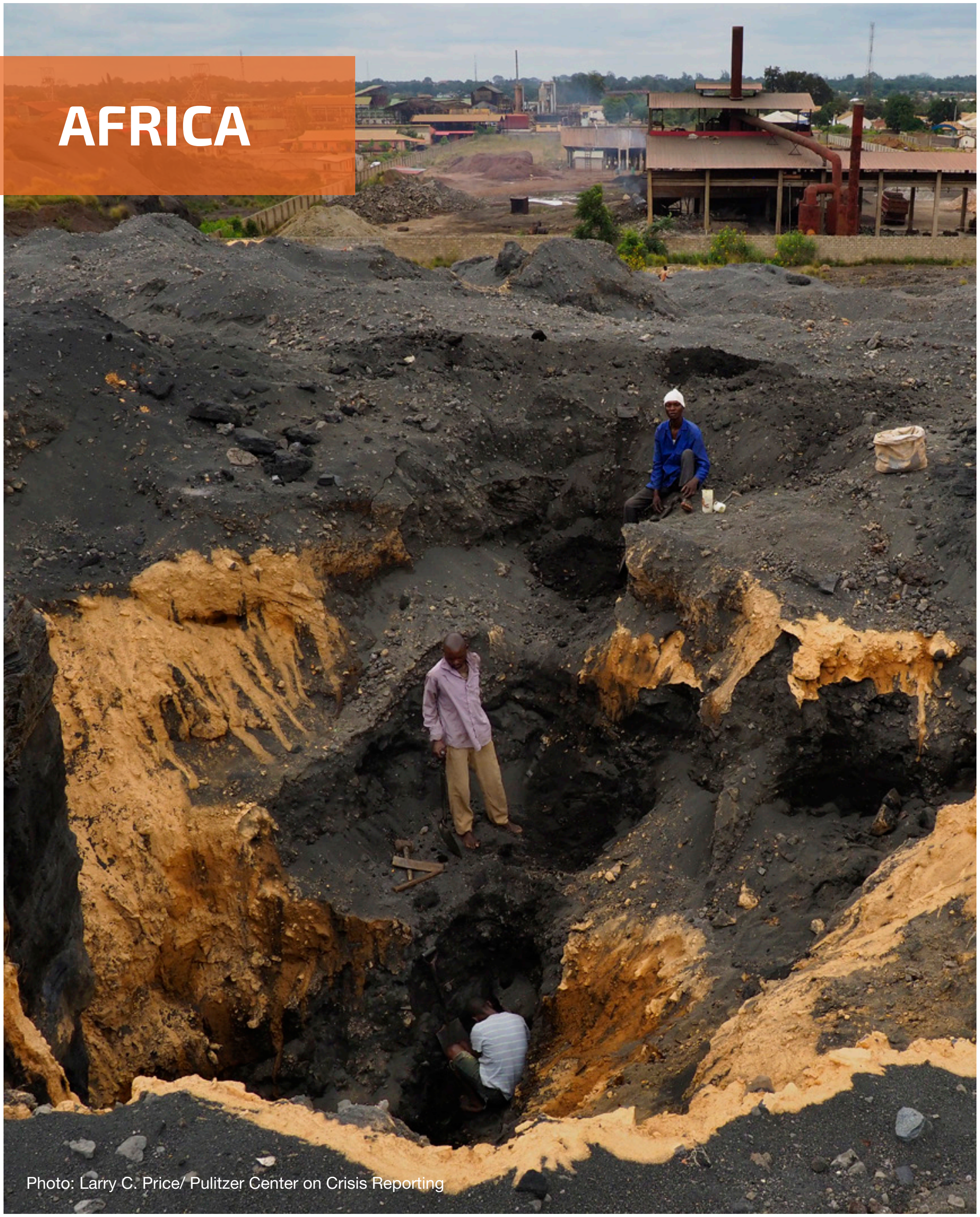


Photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

Regional Ten Highest Countries

Total Pollution Deaths[12]

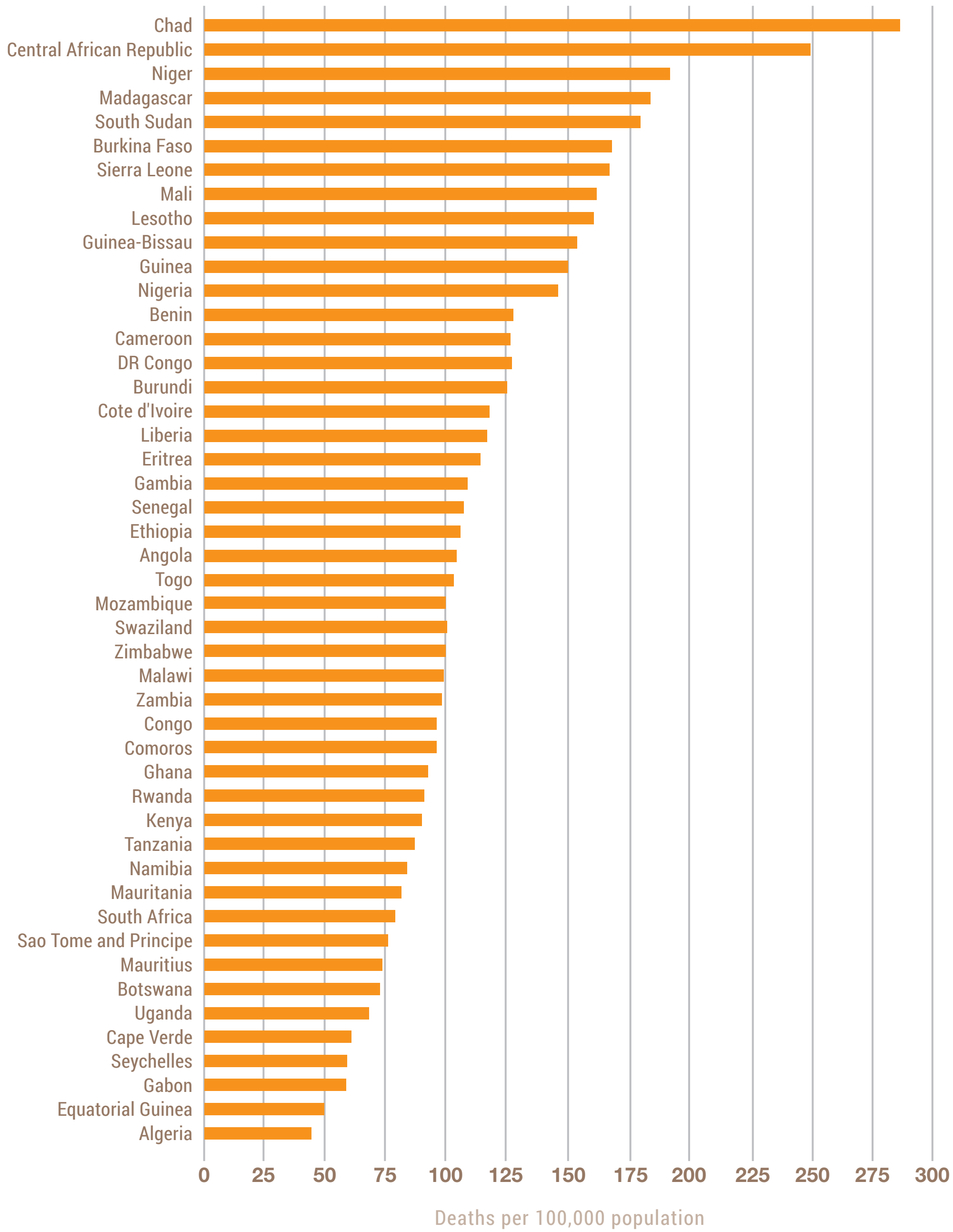
	COUNTRY	# OF DEATHS
1	NIGERIA	279,318
2	ETHIOPIA	110,787
3	DR CONGO	102,477
4	TANZANIA	49,773
5	MADAGASCAR	46,876
6	KENYA	45,001
7	SOUTH AFRICA	44,274
8	CHAD	42,765
9	NIGER	41,284
10	BURKINA FASO	32,130

Regional Ten Highest Countries

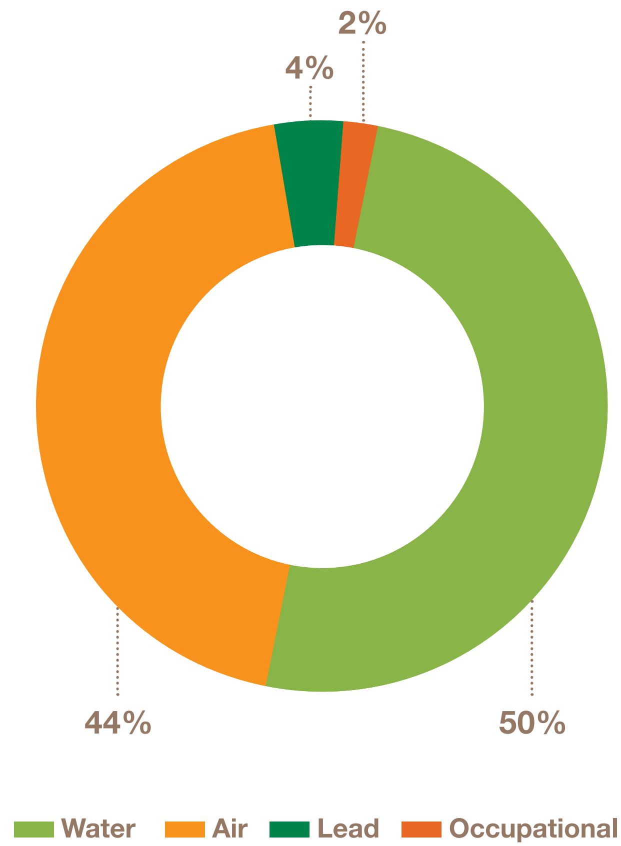
Pollution Deaths per 100,000 population[12]

	COUNTRY	RATE
1	CHAD	287
2	CENTRAL AFRICAN REPUBLIC	251
3	NIGER	192
4	MADAGASCAR	183
5	SOUTH SUDAN	180
6	BURKINA FASO	167
7	SIERRA LEONE	166
8	MALI	163
9	LESOTHO	161
10	GUINEA-BISSAU	153

African Region Death Rates from Combined Pollution Risk Factors By Country[12]



African Deaths By Pollution Type[12]



Although experiencing important advances, **Sub-Saharan Africa is considered one of the world's poorest regions**. Major challenges exist for ending poverty, and the region faces significant barriers to achieving universal access to clean water and sanitation. Saharan Africa struggles with sustainable urban development, a large contributor to the region's air pollution problems.

AMERICAS

Photo: Pure Earth

Regional Ten Highest Countries

Total Pollution Deaths[12]

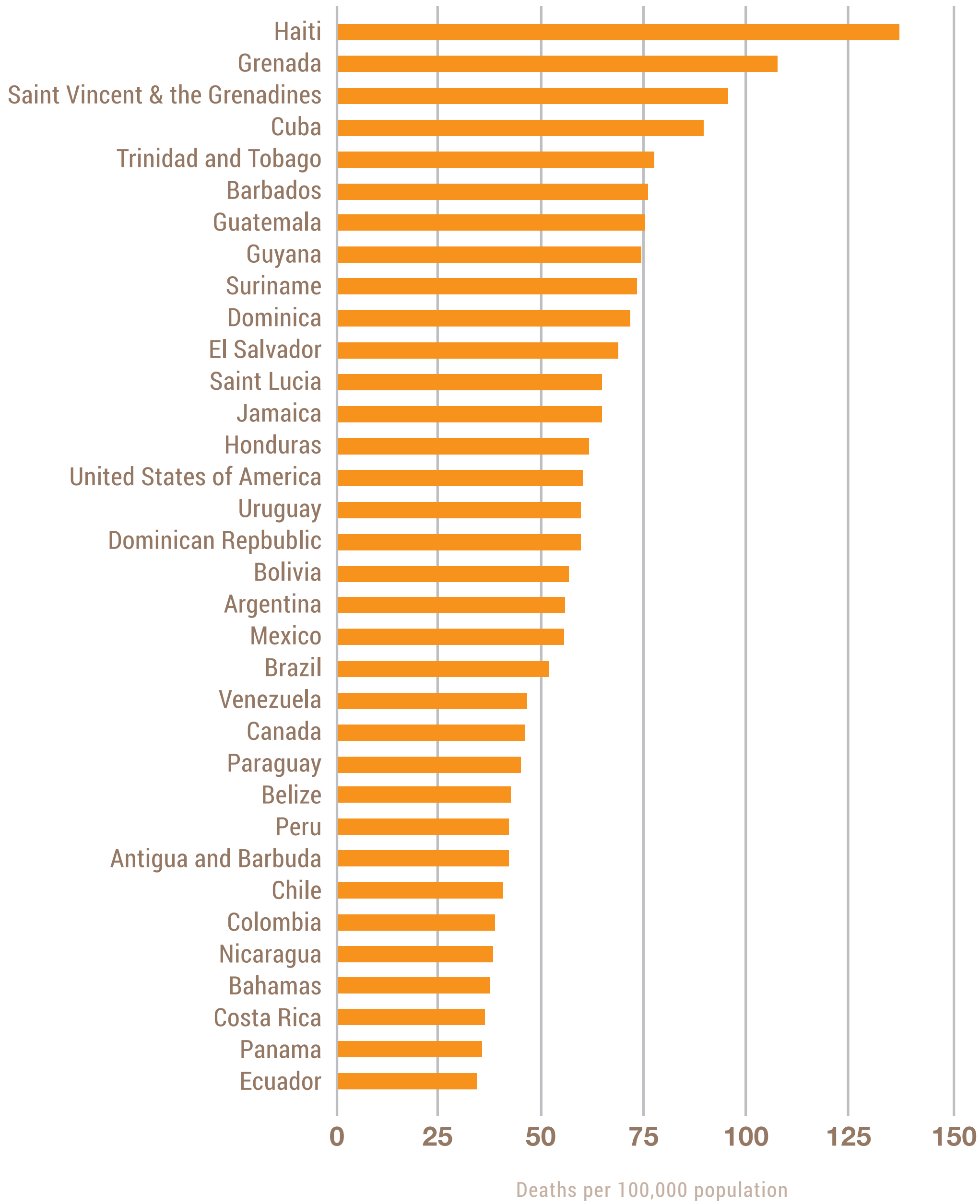
	COUNTRY	# OF DEATHS
1	UNITED STATES OF AMERICA	196,930
2	BRAZIL	109,438
3	MEXICO	72,276
4	ARGENTINA	24,827
5	COLOMBIA	19,176
6	CANADA	16,905
7	HAITI	15,079
8	VENEZUELA	14,871
9	PERU	13,472
10	GUATEMALA	12,827

Regional Ten Highest Countries

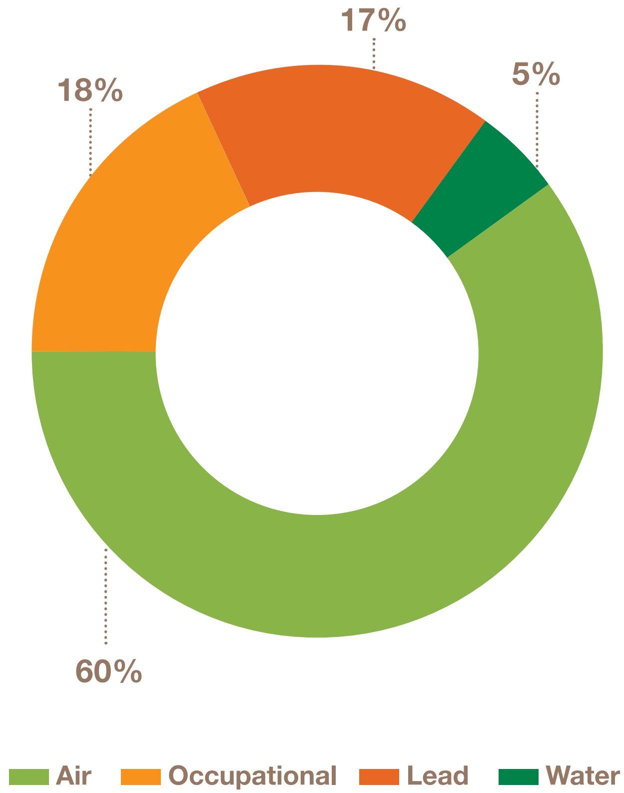
Pollution Deaths per 100,000 population[12]

	COUNTRY	RATE
1	HAITI	137
2	GRENADA	108
3	SAINT VINCENT AND THE GRENADINES	96
4	CUBA	90
5	TRINIDAD AND TOBAGO	78
6	BARBADOS	76
7	GUATEMALA	76
8	GUYANA	75
9	SURINAME	74
10	DOMINICA	72

Americas Region Death Rates from Combined Pollution Risk Factors By Country[12]



Americas Deaths By Pollution Type[12]



Extreme levels of inequality are a critical challenge in some parts of this region. However, higher levels of per capita income and higher standards of living shift pollution burdens to modern sources.

EASTERN MEDITERRANEAN

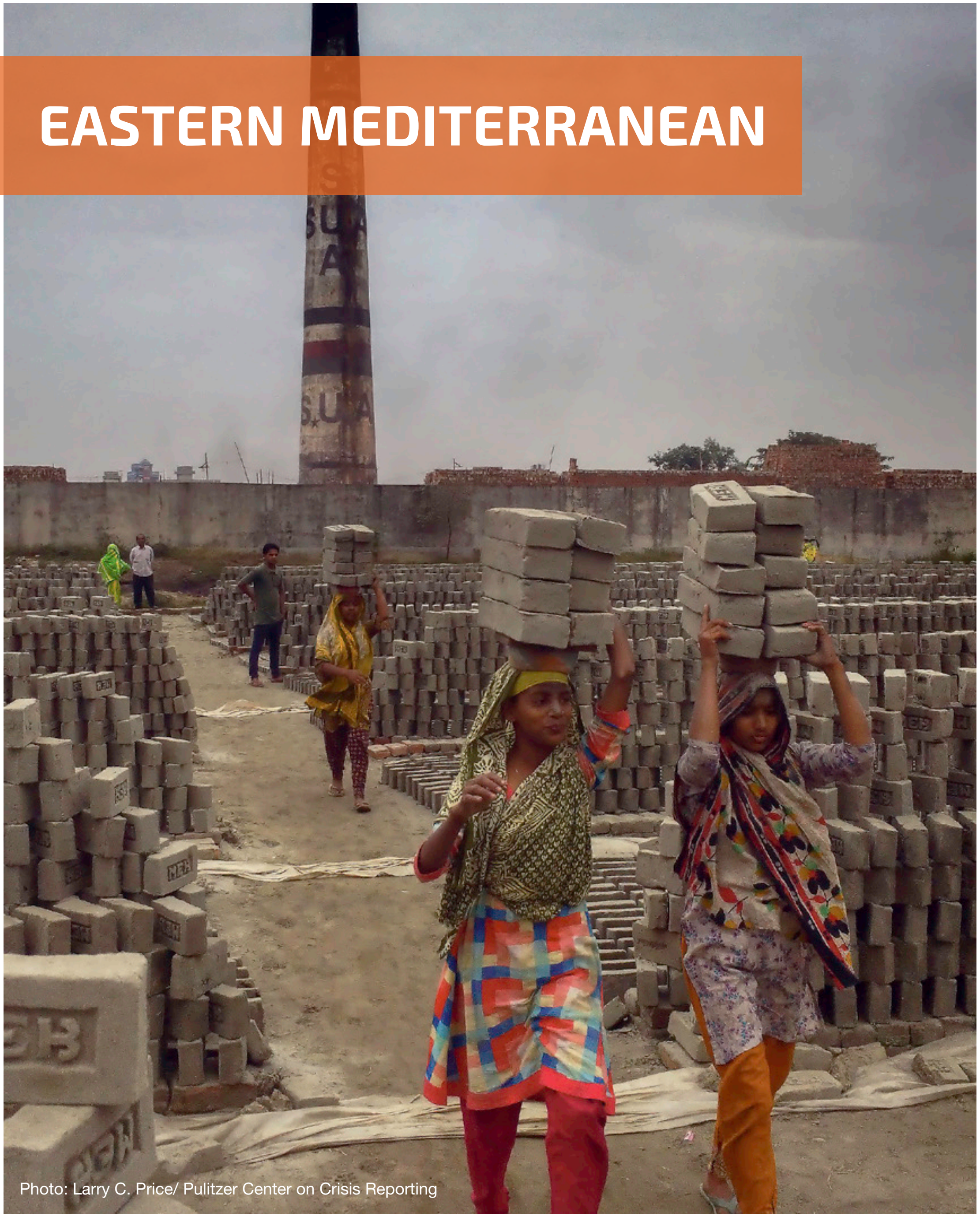


Photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

Regional Ten Highest Countries

Total Pollution Deaths[12]

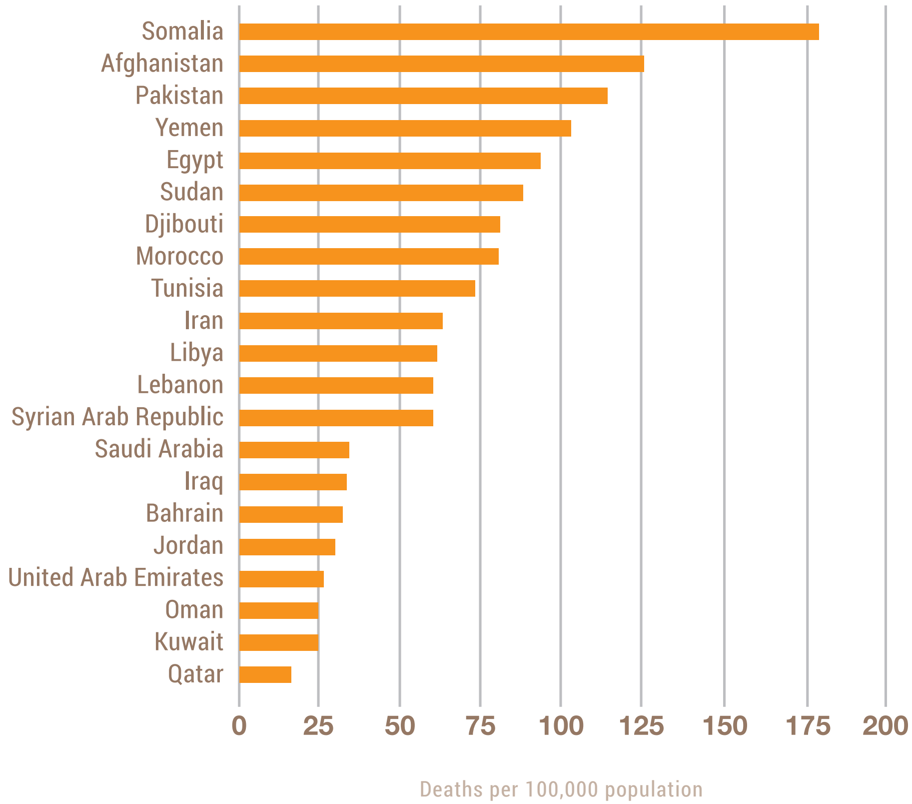
	COUNTRY	# OF DEATHS
1	PAKISTAN	223,836
2	EGYPT	90,320
3	IRAN	50,778
4	AFGHANISTAN	44,247
5	SUDAN	35,365
6	YEMEN	29,038
7	MOROCCO	28,313
8	SOMALIA	26,431
9	IRAQ	12,678
10	SAUDI ARABIA	11,033

Regional Ten Highest Countries

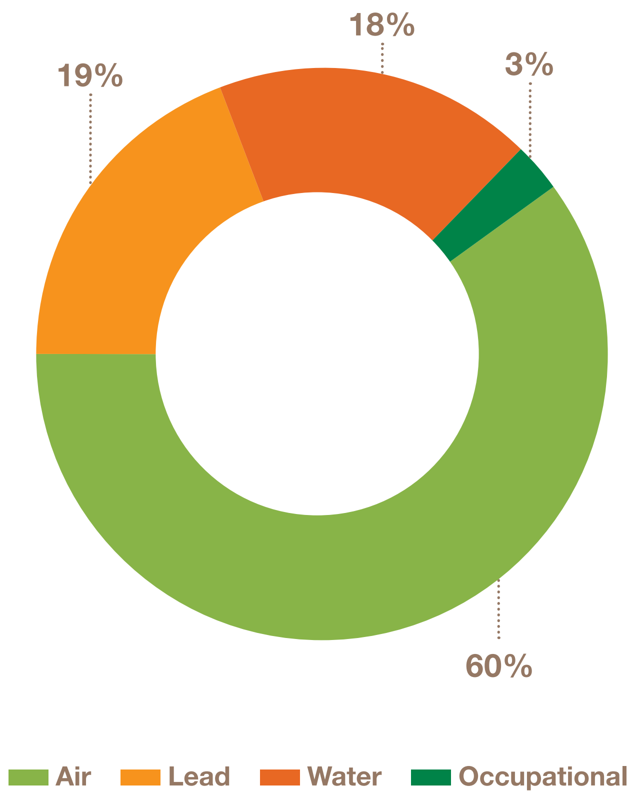
Pollution Deaths per 100,000 population[12]

	COUNTRY	RATE
1	SOMALIA	179
2	AFGHANISTAN	125
3	PAKISTAN	114
4	YEMEN	103
5	EGYPT	93
6	SUDAN	87
7	DJIBOUTI	80
8	MOROCCO	79
9	TUNISIA	73
10	IRAN	63

Eastern Mediterranean Region Death Rates from Combined Pollution Risk Factors By Country[12]



Eastern Mediterranean Deaths By Pollution Type[12]



Sustainable water management continues to challenge many of the region's countries. Countries in the region also face major challenges in updating energy infrastructure. This adds to the heavy burden of air pollution in the region.

EUROPE

Photo: Pure Earth

Regional Ten Highest Countries

Total Pollution Deaths[12]

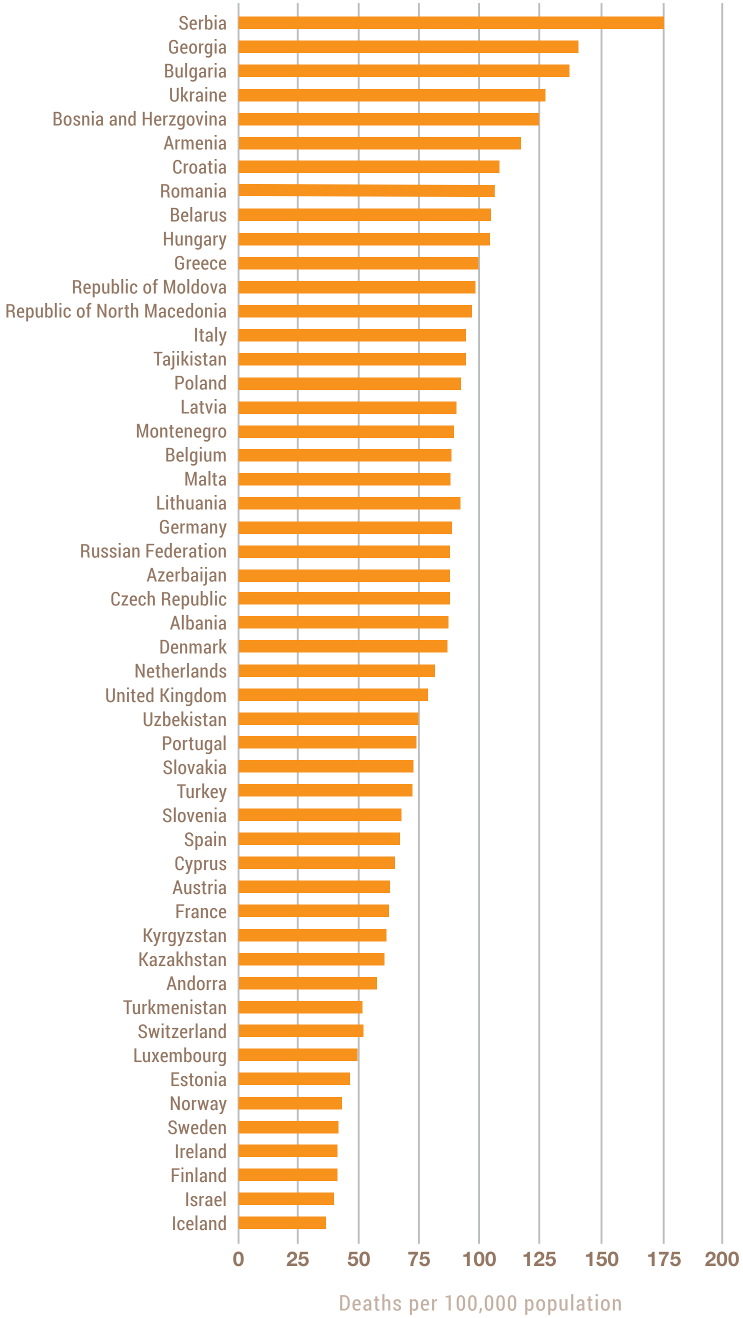
	COUNTRY	# OF DEATHS
1	RUSSIAN FEDERATION	118,687
2	GERMANY	68,300
3	TURKEY	57,779
4	UKRAINE	57,258
5	ITALY	57,033
6	UNITED KINGDOM	50,193
7	FRANCE	41,968
8	POLAND	34,905
9	SPAIN	30,923
10	UZBEKISTAN	24,274

Regional Ten Highest Countries

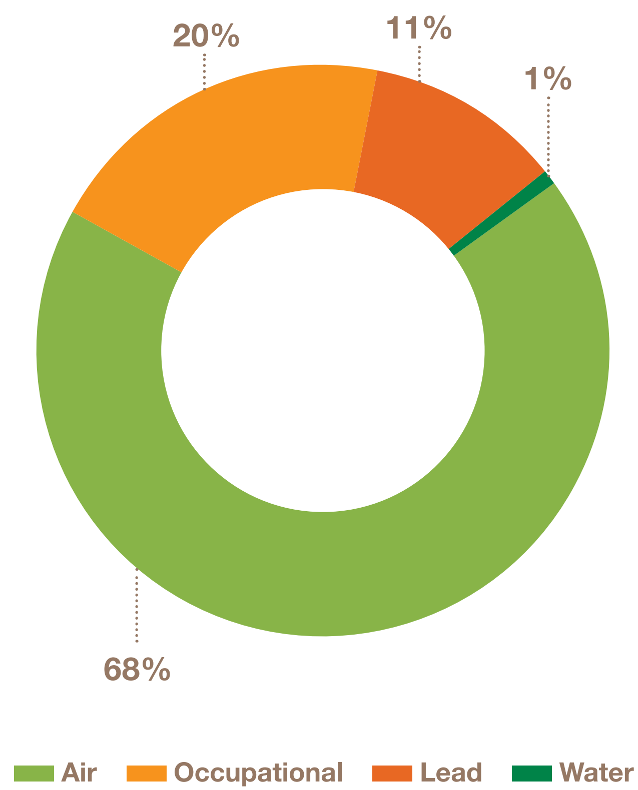
Pollution Deaths per 100,000 population[12]

	COUNTRY	RATE
1	SERBIA	175
2	GEORGIA	140
3	BULGARIA	137
4	UKRAINE	128
5	BOSNIA AND HERZEGOVINA	125
6	ARMENIA	117
7	CROATIA	108
8	ROMANIA	106
9	BELARUS	105
10	HUNGARY	105

Europe Region Death Rates from Combined Pollution Risk Factors By Country[12]



Europe Deaths By Pollution Type[12]



The countries in Eastern Europe and Central Asia have made great strides in ending extreme poverty and providing access to safe water. However, challenges remain for many countries in converting to cleaner energy sources, as noted in the **high proportion of air pollution-associated deaths**.

SOUTHEAST ASIA

Photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

Regional Ten Highest Countries

Total Pollution Deaths[12]

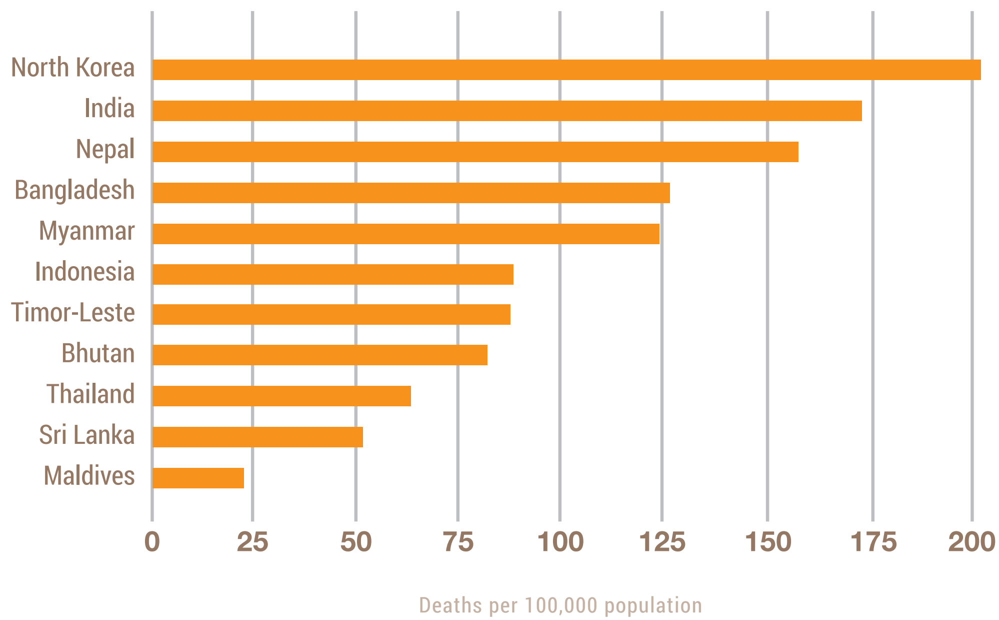
	COUNTRY	# OF DEATHS
1	INDIA	2,326,771
2	INDONESIA	232,974
3	BANGLADESH	207,922
4	MYANMAR	65,790
5	NORTH KOREA	51,391
6	NEPAL	46,149
7	THAILAND	43,538
8	SRI LANKA	11,016
9	TIMOR-LESTE	1,137
10	BHUTAN	666

Regional Ten Highest Countries

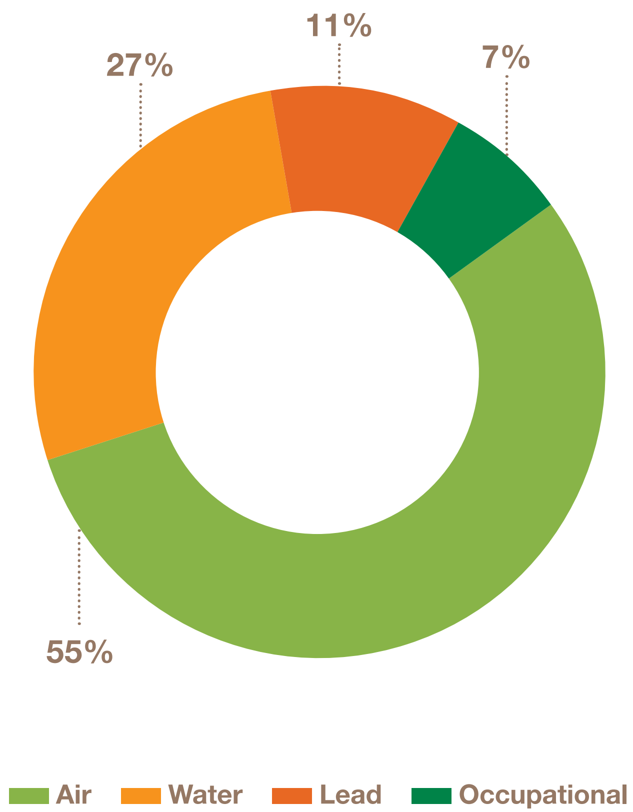
Pollution Deaths per 100,000 population[12]

	COUNTRY	RATE
1	NORTH KOREA	202
2	INDIA	174
3	NEPAL	157
4	BANGLADESH	126
5	MYANMAR	123
6	INDONESIA	88
7	TIMOR-LESTE	88
8	BHUTAN	82
9	THAILAND	63
10	SRI LANKA	51

Southeast Asia Region Death Rates from Combined Pollution Risk Factors By Country[12]



Southeast Asia Deaths By Pollution Type[12]



While notable progress has been made in reducing extreme poverty in the region, **countries still face major challenges in ensuring access to basic infrastructure services** and in providing access to water and sanitation and affordable and reliable energy. Traditional pollution from indoor cook stoves and poor water quality contribute heavily to the burden of disease.

WESTERN PACIFIC

Photo: Pure Earth

Regional Ten Highest Countries

Total Pollution Deaths[12]

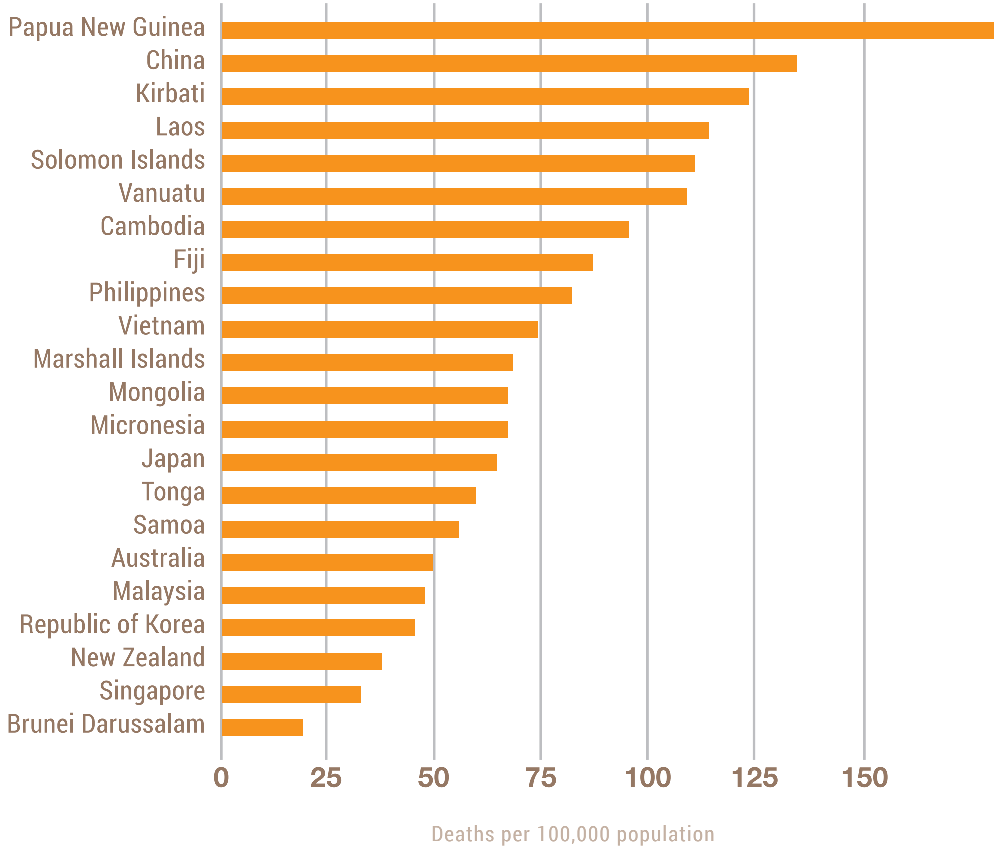
	COUNTRY	# OF DEATHS
1	CHINA	1,865,566
2	PHILIPPINES	86,650
3	JAPAN	82,046
4	VIETNAM	71,365
5	REPUBLIC OF KOREA	23,506
6	CAMBODIA	15,321
7	MALAYSIA	15,276
8	PAPUA NEW GUINEA	15,072
9	AUSTRALIA	12,392
10	LAOS	7,817

Regional Ten Highest Countries

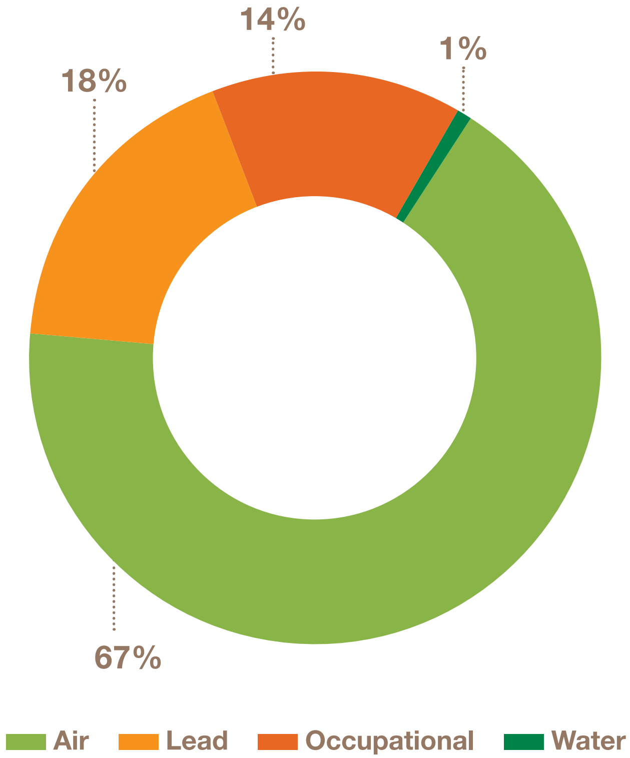
Pollution Deaths per 100,000 population[12]

	COUNTRY	RATE
1	PAPUA NEW GUINEA	183
2	CHINA	135
3	KIRIBATI	123
4	LAOS	114
5	SOLOMON ISLANDS	111
6	VANUATU	109
7	CAMBODIA	96
8	FIJI	87
9	PHILIPPINES	83
10	VIETNAM	75

Western Pacific Death Rates from Combined Pollution Risk Factors By Country[12]



Western Pacific Deaths By Pollution Type[12]



Despite notable progress in reducing extreme poverty in the region, countries still face major challenges in ensuring access to basic infrastructure services and in providing access to water, sanitation, and affordable and reliable energy. **Indoor cook stoves contribute to a heavy burden of air pollution** and associated disease. While it is not surprising that China, with its high population density, far exceeds other countries in the region in absolute number of deaths associated with pollution, Papua New Guinea, a lower-middle-income country, ranks worse with respect to pollution-related deaths per 100,000 people. Air pollution is the main pollution-related risk for death and disease in the country.

IV. GAPS IN DATA AND THEIR IMPLICATIONS

Photo: Larry C. Price/ Pulitzer Center on Crisis Reporting

As with *The Lancet* Commission Report, statistical data used in regional and country analysis for this report is derived from IHME's Global Burden of Disease (GBD) study. It is important to note that this is a limited data set. Therefore, while larger trends and basic concepts can be inferred, estimates should be taken as indicative and not definitive.

The numbers reflected in the global burden of disease are most certainly undercounts. The undercount is caused by numerous factors, including constraints on the methodology for analyzing environmental risk factors. Importantly, a lack of research and knowledge about the health effects of many pollutants, especially many newer chemical pollutants, also means that the pollution numbers reflected in this report are far from exhaustive.

The GBD study deliberately limits its analysis to risk factor-disease pairs for which there is definite or probable evidence of causality and where disease burden can reasonably be quantified. In order to establish causality, there must exist ample published research. Officially determining causality can be complicated and expensive, as can quantifying how many people may be affected and to what extent.

As an example, there are several known gaps in the GBD analysis of lead. Estimates from the GBD study indicate that lead was responsible for 1 million premature deaths and 24 million DALYs in 2017.[2] This estimate is based on disease and death in adults (15 years and older) generally exposed to legacy deposits of lead from gasoline. Cardiovascular diseases account for the overwhelming majority of these deaths. These associations are evident at blood lead concentrations as low as 5 µg/dL.[35]

Some studies have noted that average blood lead levels in many low- and middle-income countries seem to be higher than those used in the current GBD analysis. More importantly, emerging data indicate that lead in blood concentrations lower than was previously considered safe have notable impacts on hypertension, cardiovascular disease, and renal diseases. **This means that lead is likely responsible for many more deaths and much more disease than is currently counted**.

Lead is a proven neurodevelopmental toxicant. WHO estimates that in 2012, childhood lead exposure was responsible for mild to moderate mental retardation of 0.6 million children annually.[1] There is emerging evidence that lead may also contribute to neurodegenerative disease in adults. The GBD estimates do not currently capture these figures.

Current GBD methodology does not capture lead exposure and its health effects at contaminated hot spots—active and abandoned mining, smelting, and manufacturing sites in countries around the world. Battery recycling and other sources of lead exposure (lead-glazed pottery, backyard manufacturers) are extremely numerous, and their impact is significant.

As another example, mercury is a well-recognized neurodevelopmental toxicant that is distributed globally and affects the health of millions. Coal-fired power plants are a major source of mercury environmental release in high- and middle-income countries. In low-income countries, artisanal and small-scale gold mining is a major source of exposure. Health effects due to mercury are not currently counted in the GBD study.

This undercounting is one of several factors that have contributed to long-standing neglect of pollution in the international development and global health agendas and to delays in the control of pollution and prevention of pollution-related disease.

Pollutants That Have Major Associations to Health Not Currently in Global Burden of Disease Figures

Cadmium
Chromium
Endocrine Disruptors
Lead (only partially counted)
Mercury
Pesticides
Pharmaceutical Wastes
Phthalates
Plastics
Radionuclides

APPENDIX DATA SOURCES AND METHODOLOGIES

What sources provided the pollution and economic data in our analysis?

1. Institute for Health Metrics and Evaluation

Pollution risk factor data and data of other risk factors comes from the Institute for Health Metrics and Evaluation (IHME).[36] Based in Seattle, WA, IHME is an independent population health research center with a mission to improve the health of the world's population by providing open-source, high quality population health information, its determinants, and the performance of health systems along with tools to better monitor population health. IHME developed the Global Health Data Exchange (GHDx) tool,[12] an open-source catalog of surveys, censuses, vital statistics, and other health-related data. It is this dataset that *The Lancet* Commission Report used for its analysis and what we use in this report.[1]

IHME aggregates the best available health data through partnerships with researchers in almost every country around the world. Where data is unavailable, IHME looks at proxy information to help quantify disease burden. The IHME dataset is the most comprehensive dataset of global disease burden in the world.

IHME uses the Comparative Risk Assessment framework developed for previous iterations of the Global Burden of Disease Study to estimate attributable deaths, disability-adjusted life years (DALYs), and trends in exposure by age group, sex, year, and geography for behavioral, environmental and occupational, and metabolic risks or clusters of risks. Relative risk and exposure estimates were extracted from randomized controlled trials, cohorts, pooled cohorts, household surveys, census data, satellite data, and other sources. Statistical models were used to pool data, adjust for bias, and incorporate covariates.

An IHME-developed metric, summary exposure value, allowed for comparisons of exposure across risk factors. Using the counterfactual scenario of theoretical minimum risk level, IHME estimated the portion of deaths and DALYs that could be attributed to a given risk. IHME decomposed trends in attributable burden into contributions from population growth, population age structure, risk exposure, and risk-deleted cause-specific DALY rates. IHME characterized risk exposure in relation to a Socio-demographic Index (SDI).

2. World Health Organization

Country names and region designations were based on World Health Organization (WHO) Member states.[37]

As a member of the United Nations Development Group, the WHO focuses on universal health coverage. The WHO directs and coordinates international health through leadership, research, standards setting, technical support, and health monitoring.

3. Pure Earth

Pure Earth is an international non-profit organization dedicated to solving pollution problems in low- and middle-income countries where human health is at risk. Pure Earth is accredited with observer status by the UNEP Governing Council/Global Ministerial Environment Forum. Pure Earth is a leader in global toxic pollution cleanup and works cooperatively around the world in partnerships that include governments, the international community, NGOs, and local agencies, to design and implement innovative, low-cost pollution mitigation solutions to save lives.

Pure Earth established and maintains the Toxic Sites Identification Program, a pollution database which contains assessment data collected over the last decade on more than 3,500 polluted sites in more than 50 countries. Assessments are carried out by a network of national experts in each country who visit and document hazardous waste sites.

Pure Earth was responsible for calculating data pertaining to DALYs for artisanal and small-scale gold mining (ASGM) sites and used lead-acid battery (ULAB) recycling sites. Used lead-acid battery recycling sites are major sources of income generators in low- and middle-income countries worldwide and are important sources of both occupational and community exposure to lead. Artisanal and small-scale gold mining has become the world's largest source of anthropogenic mercury pollution.[8] Chronic occupational mercury poisoning caused by inhalation of mercury vapor is a major health problem among gold miners. To assess the burden of disease associated with exposures to heavy metals at these sites, new and innovative methodologies were developed for lead battery recycling sites and for gold mining sites.

4. Global Alliance on Health and Pollution (GAHP)

The Global Alliance on Health and Pollution (GAHP) is a collaborative body made up of more than 60 members and dozens of observers that advocates for resources and solutions to pollution problems. GAHP was formed because international and national level actors/agencies recognize that a collaborative, multi-stakeholder, multi-sectoral approach is necessary and critical to deal with the global pollution crisis and resulting health and economic impacts.

In 2012, Pure Earth initiated the alliance together with representatives from The World Bank, UNEP, UNDP, UNIDO, Asian Development Bank, the European

Commission, and the ministries of environment and health of many low- and middle-income countries to formulate strategies to address pollution and health at scale. GAHP, which has has proven its effectiveness, incorporated as a foundation in 2019 in Geneva, Switzerland.

GAHP's overall goal is to reduce death and illness caused by all forms of toxic pollution, including air, water, soil, and chemical wastes, especially in low- and middle-income countries. These efforts will contribute to achievement of the Sustainable Development Goals related to pollution, particularly on health.

GAHP Focuses its Efforts in Two Main Areas:

> ADVOCACY AND AWARENESS RAISING

Building public, technical, and financial support to address pollution globally by promoting scientific research, raising awareness, and tracking progress through:

- Robust and Collaborative Global
- Response to Toxic Pollution
- Research and Metrics
- Civil Society Activation
- Global Initiatives
  - Children's Global Lead (Pb) Initiative
  - Clean Air Harvest Initiative
  - Initiatives focusing on hazardous waste water management and toxic sites

> COUNTRY-SPECIFIC SUPPORT

Assisting low- and middle-income countries to prioritize and address pollution and problems through:

- Health and Pollution Action Planning
- Solutions Planning and Resource Mobilization

GAHP is unique in that it focuses on improving health as a priority and key metric for combatting pollution. GAHP is at the forefront of generating arguments (and the data and science behind them) that resonate with decision makers for investing in solutions to pollution and health problems.

To learn more about GAHP programs, go to www.gahp.net.

Methodology for Assessing the Burden of Disease Associated with Exposure to Heavy Metals at Sites

Assessing Lead Poisoning at Used Lead-Acid Battery (ULAB) Recycling Sites

Step 1

The first step in the methodology developed by Ericson et al. is to estimate the amount of lead recycled each year in each country and globally.[38] This estimation is undertaken by obtaining data on the total amount of lead entering the recycling market in each country and then subtracting out the amount recycled in commercial smelters; information on commercial smelters is obtained from the United States Geological Service. The total amount of lead entering the recycling market in a country is estimated from information on the number of the metric tons of lead recycled annually from automotive and other batteries, uninterrupted power supplies, electric bicycle batteries, and other applications such as green energy storage units. Data provided by the Organisation Internationale des Constructeurs d'Automobiles were used to determine the number of cars, trucks, and buses on the road in each country. Information on the number of motorbikes was provided by Ministries of Transport for several South Asian countries and estimated elsewhere. For China, a widely quoted estimate of 200 million electric bicycles was used. A model developed by the International Lead Association is used to determine the amount of lead contained in each type of battery.

Step 2

To estimate soil lead levels at recycling sites, Ericson et al. developed a series of nine exposure scenarios based on three smelter sizes and three levels of exposure.[38] This distribution of smelter sizes and exposure levels was based on data collected through 28 field assessments carried out by Blacksmith Institute/Pure Earth at informal used lead-acid battery recycling sites in 11 countries.

Smelting operations were divided into three categories: small, accounting for 50% of recyclers globally, with 500 people exposed per site; medium, accounting for 35% of sites with 500 persons exposed per site; and large, accounting for 15% of all operations, with 2,000 persons exposed per site. Then to capture information on varying degrees of exposure, sites of each size were divided into three exposure categories—low, medium and high on the basis of soil lead concentrations. Fifty percent of sites fell into the low exposure category (mean soil lead concentration 850 mg/ kg); 35% fell into the medium exposure category (2500 mg/ kg); and 15% into the high exposure category (5000 mg/kg).

Assessing Mercury Poisoning at Artisanal and Small-Scale Gold Mining Sites

Step 1

The first step in the methodology developed by Steckling et al. is to estimate the size of the global population of artisanal and small-scale gold miners.[8,10] This information was derived from a country-by-country census of gold mining populations undertaken by Seccatore et al., supplemented by a structured literature review.[9]

Step 2

Estimates were developed of the prevalence of moderate mercury poisoning among miners by compiling a dataset of all available studies that measured urine mercury levels and that had also assessed frequency of symptoms of mercury poisoning in miners using a standardized diagnostic tool developed by Drasch and Doering.[40,41] Severe cases were not included in the analysis of because severely poisoned miners can no longer be employed. Cases in workers' families and communities also were not considered.

Methodology for Assessing the Burden of Disease Associated with Exposure to Heavy Metals at Sites

Assessing Lead Poisoning at Used Lead-Acid Battery (ULAB) Recycling Sites	Assessing Mercury Poisoning at Artisanal and Small-Scale Gold Mining Sites
Step 3 To estimate the distribution of blood lead levels at sites from soil lead data, researchers used the US Environment Protection Agency's Integrated Exposure Uptake Biokinetic Models for Lead in Children (IEUBK) and Adults.[39] **Step 4** Exposure-response algorithms developed by the World Health Organization were used to estimate the burden of disease at each site by combining blood lead data with data on population size and age structure. No mortality from lead poisoning was assumed in this analysis, and therefore the estimated burden of disease is based solely on Years Lived with Disability (YLDs).	**Step 3** The burden of disease associated with moderate mercury poisoning among miners was quantified in each country and globally by multiplying the number of prevalent cases by the appropriate disability weight and the number of miners. No mortality was assumed in this analysis, and, therefore, the estimated burden of disease is based solely on Years Lived with Disability (YLDs). In future iterations, this methodology will be expanded to include severe cases of mercury poisoning caused by elemental mercury in artisanal and small-scale gold mining as well as community cases.

APPENDIX COUNTRY DATA IN DETAIL[12]

Country	Pollution Death Rate	Death Rate Ranking	Total Pollution Deaths	Air Pollution Deaths	Water Pollution Deaths	Occupational Pollution Deaths	Lead Deaths
Afghanistan	125	30	44,247	26,054	8,048	605	9,539
Albania	79	92	2,269	1,639	9	149	472
Algeria	43	159	17,940	13,222	383	709	3,626
Andorra	58	140	45	23	0	18	3
Angola	104	49	30,842	10,728	18,846	354	914
Antigua and Barbuda	42	163	43	31	3	2	7
Argentina	56	144	24,827	17,011	827	4,345	2,644
Armenia	117	33	3,434	2,630	18	390	396
Australia	50	150	12,392	4,884	88	5,217	2,203
Austria	63	126	5,503	3,489	17	1,406	590
Azerbaijan	81	88	7,954	6,339	193	430	992
Bahamas	38	171	150	112	7	11	20
Bahrain	32	181	472	407	8	29	28
Bangladesh	126	25	207,922	122,734	33,583	13,558	38,048
Barbados	76	97	218	172	11	10	25
Belarus	105	47	9,962	8,265	21	507	1,169
Belgium	89	74	10,139	4,980	84	3,352	1,722
Belize	43	160	160	109	17	13	21
Benin	128	23	14,312	6,182	7,278	259	593

Country	Pollution Death Rate	Death Rate Ranking	Total Pollution Deaths	Air Pollution Deaths	Water Pollution Deaths	Occupational Pollution Deaths	Lead Deaths
Bhutan	82	85	666	397	117	67	85
Bolivia	57	142	6,312	4,263	651	573	826
Bosnia and Herzegovina	125	29	4,379	3,372	7	302	699
Botswana	72	109	1,647	822	609	90	126
Brazil	52	146	109,438	66,245	7,152	14,462	21,580
Brunei Darussalam	20	187	84	52	2	18	11
Bulgaria	137	21	9,706	7,684	19	567	1,435
Burkina Faso	167	11	32,130	15,212	14,760	331	1,827
Burundi	126	28	13,650	6,520	6,372	261	497
Cambodia	96	62	15,321	10,744	2,074	974	1,528
Cameroon	126	26	30,344	13,301	14,459	723	1,860
Canada	46	156	16,905	7,835	196	7,601	1,272
Cape Verde	61	131	331	230	59	11	31
Central African Republic	251	2	11,672	4,711	6,529	125	307
Chad	287	1	42,765	14,329	26,992	266	1,178
Chile	40	167	7,306	5,666	221	1,093	327
China	135	22	1,865,566	1,242,987	9,585	255,580	357,414
Colombia	39	169	19,176	11,963	870	2,290	4,053
Comoros	95	63	777	392	314	24	46
Congo	96	61	5,045	2,440	2,333	122	150
Costa Rica	36	174	1,787	1,042	73	195	477
Cote d'Ivoire	117	34	28,445	13,404	13,237	409	1,395

Country	Pollution Death Rate	Death Rate Ranking	Total Pollution Deaths	Air Pollution Deaths	Water Pollution Deaths	Occupational Pollution Deaths	Lead Deaths
Croatia	108	42	4,463	3,089	14	1,011	349
Cuba	90	72	10,325	6,236	442	1,064	2,583
Cyprus	65	123	763	499	3	170	90
Czech Republic	80	90	8,446	6,461	77	1,225	682
Democratic Republic of the Congo	126	27	102,477	53,515	44,472	1,578	2,911
Denmark	77	95	4,430	2,366	35	1,757	272
Djibouti	80	89	765	404	305	19	36
Dominica	72	108	53	36	3	4	10
Dominican Republic	60	137	6,447	3,364	626	267	2,191
Ecuador	35	176	5,759	3,851	482	574	852
Egypt	93	66	90,320	60,543	5,459	2,232	22,086
El Salvador	69	113	4,426	2,654	376	171	1,225
Equatorial Guinea	49	152	618	335	235	15	34
Eritrea	114	36	7,684	3,144	4,156	143	242
Estonia	47	154	618	452	3	97	65
Ethiopia	106	46	110,787	40,614	63,454	1,931	4,788
Fiji	87	79	787	669	72	25	21
Finland	41	166	2,251	1,127	7	1,003	113
France	63	127	41,968	18,992	241	16,540	6,195
Gabon	58	141	1,167	674	412	36	46
Gambia	108	43	2,271	1,281	773	43	173

Country	Pollution Death Rate	Death Rate Ranking	Total Pollution Deaths	Air Pollution Deaths	Water Pollution Deaths	Occupational Pollution Deaths	Lead Deaths
Georgia	140	19	5,234	4,208	28	453	545
Germany	83	83	68,300	41,839	446	21,368	4,648
Ghana	92	67	26,531	15,080	9,594	684	1,173
Greece	99	55	10,665	6,944	28	1,781	1,912
Grenada	108	41	117	81	6	5	25
Guatemala	76	99	12,827	7,185	3,200	287	2,155
Guinea	150	17	19,023	10,514	6,905	329	1,274
Guinea-Bissau	153	16	2,849	1,181	1,460	41	167
Guyana	75	102	582	361	65	18	139
Haiti	137	20	15,079	7,854	4,331	376	2,517
Honduras	62	128	5,714	2,921	1,044	278	1,471
Hungary	105	48	10,240	7,771	89	1,357	1,023
Iceland	37	173	126	59	1	53	13
India	174	10	2,326,771	1,240,529	698,597	153,528	234,117
Indonesia	88	75	232,974	123,753	60,040	16,331	32,850
Iran	63	125	50,778	29,098	779	3,659	17,241
Iraq	33	178	12,678	9,427	578	389	2,284
Ireland	41	165	1,995	1,111	11	623	249
Israel	39	168	3,431	2,597	41	516	278
Italy	94	64	57,033	29,368	170	17,445	10,051
Jamaica	65	121	1,877	1,232	67	159	419
Japan	65	122	82,046	49,554	1,899	25,448	5,146

Country	Pollution Death Rate	Death Rate Ranking	Total Pollution Deaths	Air Pollution Deaths	Water Pollution Deaths	Occupational Pollution Deaths	Lead Deaths
Jordan	29	182	2,797	1,949	65	148	635
Kazakhstan	60	134	10,869	7,996	133	1,288	1,451
Kenya	91	71	45,001	18,891	23,454	1,164	1,493
Kiribati	123	31	144	102	32	2	7
Kuwait	24	185	993	832	17	39	106
Kyrgyzstan	61	129	3,792	2,813	137	244	599
Laos	114	37	7,817	5,010	1,730	369	708
Latvia	91	70	1,759	1,458	7	148	147
Lebanon	60	136	3,643	2,762	81	202	599
Lesotho	161	14	3,599	1,722	1,428	182	266
Liberia	116	35	5,501	2,329	2,786	64	322
Libya	61	130	3,887	3,061	82	261	482
Lithuania	87	81	2,449	2,054	14	198	183
Luxembourg	49	151	295	168	2	102	23
Macedonia	96	59	2,005	1,663	4	90	248
Madagascar	183	5	46,876	18,722	25,628	907	1,620
Malawi	99	56	18,429	8,772	8,242	384	1,031
Malaysia	48	153	15,276	11,352	678	1,375	1,871
Maldives	22	186	95	56	4	15	20
Mali	163	13	30,135	11,522	16,584	487	1,543
Malta	88	76	413	217	1	97	97
Marshall Islands	68	114	36	28	2	3	3

Country	Pollution Death Rate	Death Rate Ranking	Total Pollution Deaths	Air Pollution Deaths	Water Pollution Deaths	Occupational Pollution Deaths	Lead Deaths
Mauritania	81	87	3,575	1,658	1,662	63	191
Mauritius	73	107	919	755	10	61	93
Mexico	56	145	72,276	48,071	3,234	6,084	14,887
Micronesia	67	118	71	57	3	6	5
Mongolia	68	116	2,078	1,664	62	79	273
Montenegro	89	73	556	470	1	38	47
Morocco	79	91	28,313	19,696	1,088	1,185	6,345
Mozambique	100	52	29,817	14,473	12,394	571	2,379
Myanmar	123	32	65,790	45,383	9,188	6,762	4,457
Namibia	84	82	2,123	1,029	854	108	131
Nepal	157	15	46,149	25,689	10,792	3,407	6,261
Netherlands	77	96	13,156	6,714	57	5,646	739
New Zealand	38	172	1,805	697	24	825	259
Nicaragua	38	170	2,382	1,509	200	116	558
Niger	192	4	41,284	15,428	24,116	314	1,426
Nigeria	146	18	279,318	114,115	159,777	2,088	3,338
North Korea	202	3	51,391	38,768	404	7,804	4,415
Norway	43	161	2,253	1,153	31	843	226
Oman	24	184	1,116	902	25	36	153
Pakistan	114	38	223,836	128,005	60,213	8,787	26,831
Palestine	33	180	1,540	1,124	54	51	311
Panama	36	175	1,460	853	165	110	332

Country	Pollution Death Rate	Death Rate Ranking	Total Pollution Deaths	Air Pollution Deaths	Water Pollution Deaths	Occupational Pollution Deaths	Lead Deaths
Papua New Guinea	183	6	15,072	10,164	3,499	1,103	306
Paraguay	45	158	3,075	2,113	200	254	509
Peru	42	162	13,472	9,573	1,731	1,023	1,146
Philippines	83	84	86,650	64,386	9,029	5,067	8,168
Poland	92	68	34,905	24,629	149	6,131	3,995
Portugal	74	104	7,639	4,329	82	1,394	1,834
Qatar	15	188	397	345	4	26	22
Republic of Korea	46	157	23,506	17,343	338	3,737	2,087
Republic of Moldova	98	57	3,492	2,787	35	130	540
Romania	106	45	20,755	15,126	123	2,022	3,483
Russian Federation	82	86	118,687	99,392	685	9,634	8,976
Rwanda	91	69	11,075	5,524	4,747	356	449
Saint Lucia	65	120	117	80	5	8	23
Saint Vincent and the Grenadines	96	60	106	66	6	4	29
Samoa	56	143	111	95	4	6	5
Sao Tome and Principe	75	100	154	105	29	8	12
Saudi Arabia	33	177	11,033	8,732	219	290	1,793
Senegal	106	44	16,801	7,875	7,830	339	757
Serbia	175	9	12,317	9,902	37	1,012	1,366
Seychelles	59	139	56	41	4	5	6
Sierra Leone	166	12	12,573	6,102	5,658	165	647

Country	Pollution Death Rate	Death Rate Ranking	Total Pollution Deaths	Air Pollution Deaths	Water Pollution Deaths	Occupational Pollution Deaths	Lead Deaths
Singapore	33	179	1,853	1,318	33	281	221
Slovakia	72	110	3,901	3,145	15	342	400
Slovenia	68	115	1,397	915	5	373	104
Solomon Islands	111	39	679	557	62	21	39
Somalia	179	8	26,431	12,357	12,177	409	1,487
South Africa	78	93	44,274	23,547	14,829	3,471	2,427
South Sudan	180	7	22,617	9,074	12,780	222	540
Spain	66	119	30,923	17,133	151	8,163	5,476
Sri Lanka	51	149	11,016	8,407	758	981	870
Sudan	87	78	35,365	18,079	9,030	620	7,636
Suriname	74	105	415	269	44	19	83
Swaziland	100	53	1,286	567	588	63	68
Sweden	42	164	4,194	2,257	63	1,528	347
Switzerland	52	148	4,386	2,313	24	1,529	520
Syrian Arab Republic	59	138	10,793	7,611	94	358	2,729
Taiwan	72	111	16,878	12,722	192	2,287	1,677
Tajikistan	94	65	8,398	5,318	1,783	143	1,156
Tanzania	87	80	49,773	27,055	19,604	1,035	2,079
Thailand	63	124	43,538	30,625	5,379	5,406	2,127
Timor-Leste	88	77	1,137	751	186	69	131
Togo	103	51	8,013	3,801	3,638	154	420
Tonga	60	135	65	53	3	6	2

Country	Pollution Death Rate	Death Rate Ranking	Total Pollution Deaths	Air Pollution Deaths	Water Pollution Deaths	Occupational Pollution Deaths	Lead Deaths
Trinidad and Tobago	78	94	1,063	906	35	47	75
Tunisia	73	106	8,434	5,757	147	496	2,034
Turkey	72	112	57,779	39,985	731	11,889	5,175
Turkmenistan	52	147	2,992	2,413	95	86	398
Uganda	67	117	28,837	13,599	13,542	608	1,088
Ukraine	128	24	57,258	50,130	249	3,071	3,808
United Arab Emirates	27	183	2,509	2,072	46	238	153
United Kingdom	76	98	50,193	24,794	297	21,956	3,146
United States of America	61	132	196,930	107,507	1,628	59,536	28,260
Uruguay	60	133	2,086	1,194	80	442	370
Uzbekistan	75	101	24,274	19,856	443	580	3,394
Vanuatu	109	40	302	223	41	22	16
Venezuela	47	155	14,871	9,197	983	1,134	3,557
Vietnam	75	103	71,365	50,232	3,097	9,809	8,227
Yemen	103	50	29,038	12,379	8,087	550	8,022
Zambia	97	58	16,600	7,106	8,691	310	492
Zimbabwe	100	54	16,518	9,021	6,079	457	961

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Authors:
Richard Fuller
Karti Sandilya
David Hanrahan

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For questions, comments, and feedback,
please contact:
Angela Bernhardt
angela@gahp.net

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US | **Global Alliance on Health and Pollution**
c/o Pure Earth
475 Riverside Drive, Suite 860
New York, NY 10115
www.gahp.net

Switzerland | **Global Alliance on Health and Pollution**
c/o SPTS Sarl
Chemin de la Chesnaie 8
1219 Châtelaine, Geneva
Switzerland

For more information,
contact Rachael Kupka at
rachael@gahp.net