



# Air Pollution: A Modern-Day Underwriting Risk

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*Long-term exposure to air pollution is associated with chronic respiratory disease and compromised immunity, increasing the risk of severe outcomes and early mortality globally.*

## Introduction

The World Health Organization (WHO) predicts that by 2030 respiratory diseases will be the leading cause of mortality and morbidity. In 2016, air pollution reduced global life expectancy by one year and eight months on average and is among the top five risk factors for population health. Ozone exposure, fine particulate matter (PM<sub>2.5</sub>), and coarse particulate matter (PM<sub>10</sub>) are the air pollutants most widely recognized as being harmful to human health.<sup>1,2</sup>

## Cause and effect of air pollution

PM<sub>2.5</sub> are low-lying airborne particles measuring up to 2.5 microns (µm) in size and are formed by sources such as the burning of solid fuels and vehicle exhaust fumes. They can enter the blood stream via the respiratory system and are particularly harmful as they penetrate deep into the lungs, contributing to long-term health problems such as asthma, cancer, and heart disease.<sup>3</sup>

The resulting irritation from airborne particles in the respiratory tract can lead to an inflammatory response in the lungs. Long-term exposure to air pollution increases the risk of non-communicable diseases such as chronic obstructive pulmonary disease (COPD) and diabetes. In 2017, exposure to PM<sub>2.5</sub> was the third leading risk factor for Type 2 diabetes deaths, after high blood sugar and high body mass index (BMI).<sup>1</sup> (Read more on [obesity, the “silent pandemic.”](#))

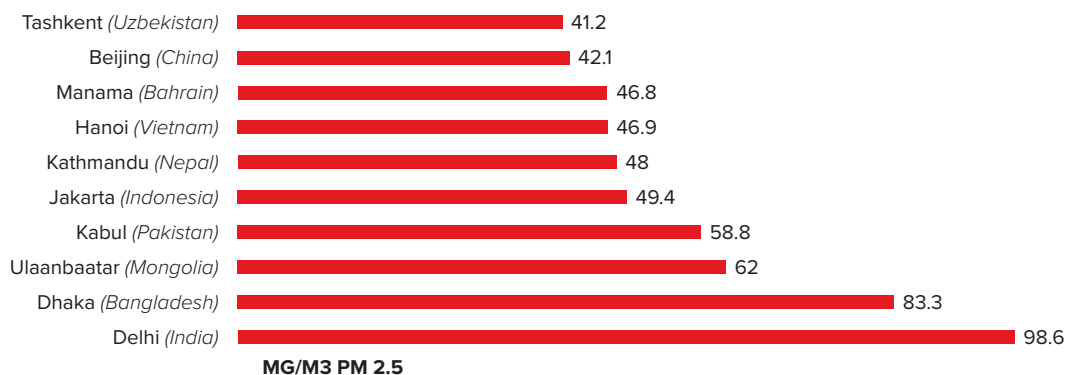
Other systemic effects can result in an increased risk of coagulability, cytokine storm syndrome, and cardiovascular events. Cytokine storm syndrome is a severe reaction of the immune system, causing an uncontrolled release of pro-inflammatory cytokines. This can cause life-threatening symptoms such as hypotensive shock and multi-organ failure.

The WHO considers anything above an annual mean concentration of 25 micrograms per cubic meter (µg/m<sup>3</sup> PM<sub>2.5</sub>) to be unsafe. Globally, 92% of people live in places where the most stringent WHO target of 10 µg/m<sup>3</sup> is exceeded, and 54% live in areas where the least stringent WHO target of 35 µg/m<sup>3</sup> is exceeded. At this level, mortality risk is about 15% higher relative to 10 µg/m<sup>3</sup>.<sup>4</sup>

## Air pollution around the world

In 2019, Bangladesh was the most polluted country as measured by PM<sub>2.5</sub> exposure, with an annual average concentration of 83.3 µg/m<sup>3</sup>, followed by Pakistan (65.8), Mongolia (62.0), Afghanistan (58.8), and India (58.1). Delhi, India (98.6 µg/m<sup>3</sup>) topped the ranking as the most polluted city in the world for the second consecutive year.<sup>3</sup>

**Figure 1: Top 10 most polluted capital cities by average annual concentration of PM<sub>2.5</sub>**<sup>1</sup>



Air quality in East Asia is particularly poor due to a high dependence on coal for energy production and domestic heating. Beijing, China, which is historically known for having some of the world's worst air pollution, has seen a continual decline in PM<sub>2.5</sub> exposure since 2013. In fact, August 2019 marked Beijing's cleanest month in 2019.<sup>3</sup> Despite continued improvement in Beijing, studies also show that Beijing residents die on average 5.5 years early because of air pollution.<sup>1,2</sup> The 2017 Global Burden of Diseases study shows that there were an estimated 178,000 excess deaths from chronic respiratory disease in China in 2017. Chronic respiratory diseases remain among the top five causes of death. Air pollution costs an estimated 1.1 million lives annually in China alone.

Bosnia and Herzegovina is the worst country in Europe for PM<sub>2.5</sub> pollution (34.6 µg/m<sup>3</sup>). In the Middle East, Manama, Dubai, Baghdad, Abu Dhabi, and Kuwait City all have high levels of PM<sub>2.5</sub>, in part due to the numerous sandstorms that occur during summer months. The U.S. and Canada remain two of the regions in the world with the lowest PM<sub>2.5</sub> levels, even though 20% of regional cities fail to meet WHO air quality guidelines. There are still 30,000 premature deaths annually as a result of air pollution. In the United States, 19 out of the 20 most polluted cities are in the state of California. Were it not for the Australian bushfires in 2019, Oceania would have surpassed North America as the cleanest region in the world. In South America, Peru (23.3 µg/m<sup>3</sup>) and Chile (22.6 µg/m<sup>3</sup>) have the highest levels of air pollution, which are driven by vehicle emissions and burning fossil fuels for household heating. In Africa, air pollution is worst (and continues to worsen) in Democratic Republic of the Congo and Ghana.<sup>3</sup>

It is of interest to note that the lockdowns many countries imposed to contain the spread of COVID-19 directly impacted levels of air pollution. Data shows that cities across the world are recording much lower levels of PM<sub>2.5</sub>. In New Delhi, India, PM<sub>2.5</sub> levels fell by 71% in just one week, declining from 91 to 26 µg/m<sup>3</sup> by March 27, 2020. Only a few months prior in November 2019, air pollution had hit record high levels, causing schools to close and flights to be diverted. India has one of the highest rates of respiratory disease in the world, and this may have a significant impact on the number of infections and deaths from COVID-19. Many of the diseases that are caused by long-term exposure to air pollution are the same ones that increase the risk of severe illness and death in patients with COVID-19.<sup>5</sup> (See RGA's [COVID-19 Brief](#) on air pollution.)

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## Chronic obstructive pulmonary disease (COPD)

COPD is a common but preventable disorder associated with a restriction of airflow to the lungs. Generally, symptoms of COPD such as breathlessness, a chronic cough, and excess mucous production become apparent after 40 or 50 years of age. Diagnosis of COPD is made based on pulmonary function tests, lung diffusion capacity tests, chest X-rays, and arterial blood gas tests.<sup>6</sup> COPD is not curable but is usually managed with medication to help relieve symptoms.

In 2016, global prevalence of COPD was estimated at 251 million cases. Data from the U.S. Behavioral Risk Factor Surveillance System (BRFSS) in 2017 data indicates that 6.2% of adults in the U.S. have been diagnosed with COPD.<sup>7</sup> Prevalence in Europe in 2018 ranged from as low as 2% in parts of Sweden to 26% in Manchester, U.K., and Salzburg, Austria.<sup>8</sup>

**Table: Prevalence of COPD by European regions<sup>8</sup>**

Region	No. of studies	Mean prevalence (%)	95% CI (lower)	95% CI (upper)
Western Europe	11	14.2	8.8	19.6
Central Europe	14	14.1	10.4	17.9
Europe	62	12.4	10.8	14.0
Northern Europe	21	11.5	8.8	14.1
Southern Europe	16	10.8	7.8	13.8

## Air pollution, COPD, and mortality

Since 1990, there has been a 68% increase in the number of global deaths as a result of PM<sub>2.5</sub> air pollution. In 2017, air pollution contributed to 9% of deaths worldwide and was the fifth leading mortality risk factor worldwide.<sup>9</sup> Global mortality due to air pollution is estimated at 8.8 million deaths per year. By comparison, global mortality from tobacco smoking is estimated at 7.2 million deaths per year. More than 90% of deaths from COPD occur in low- and middle-income countries, where air pollution continues to increase daily.<sup>2</sup> Annual mortality as a percent of the population and linked to air pollution is highest in East Asia (35%), followed by South Asia (32%), Africa (11%) and Europe (9%), with complications from COPD. Complications from COPD were a leading cause of death in both China and the U.S.<sup>3,6</sup> Air pollution accounts for 41% of all global deaths from COPD and 19% of deaths from lung cancer, taking its greatest toll on those aged 50 and older. In 2017, 88% of deaths caused by PM<sub>2.5</sub> were in those aged 50 and older.<sup>1</sup>

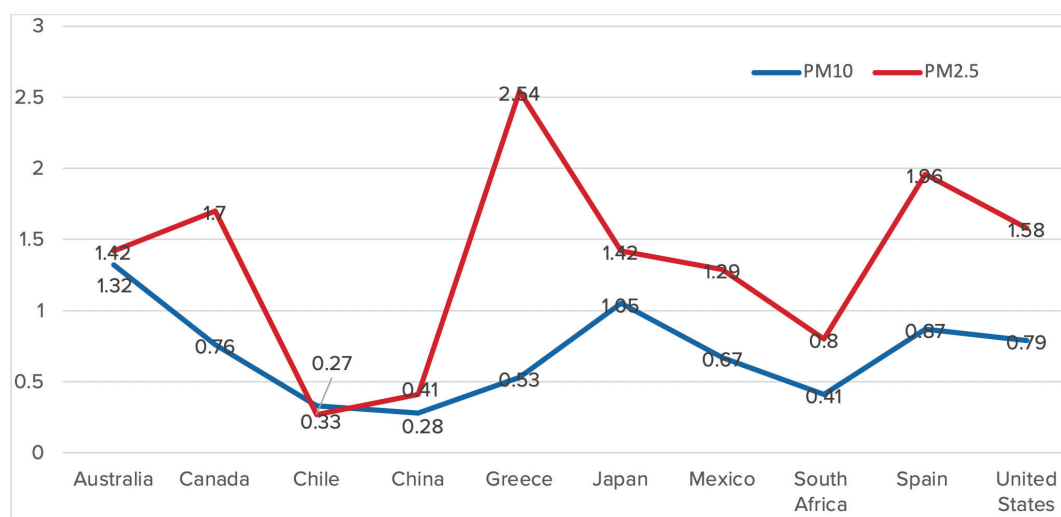
**Figure 2: Top 10 countries by mortality burden attributable to air pollution (2017)<sup>1</sup>**



A study on ambient particulate matter air pollution and daily mortality in 24 countries showed that an increase of 10  $\mu\text{g}/\text{m}^3$  in the two-day moving average of PM<sub>10</sub> was associated with increases of 0.44% in all-cause mortality and 0.47% in respiratory mortality.<sup>10</sup>

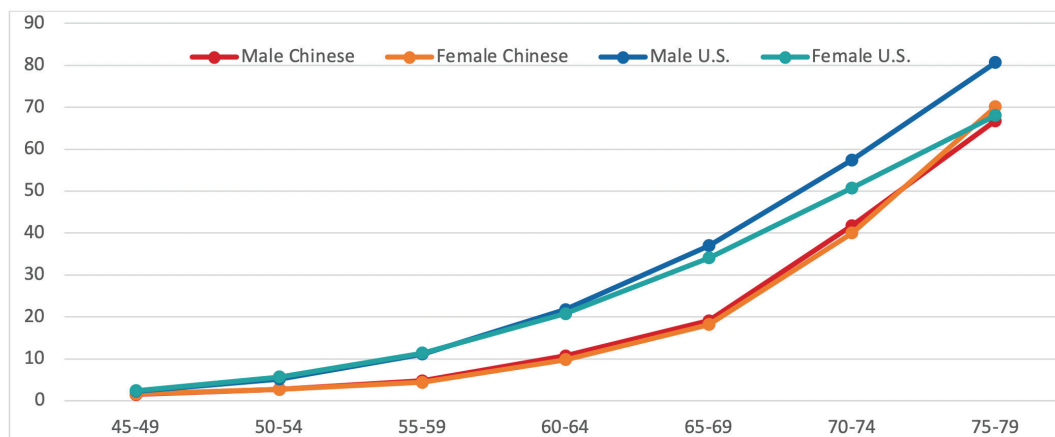
The Air Pollution and Health: A European and North American Approach (APHENA) study found increases in daily all-cause mortality of 0.86% in Canada, 0.33% in Europe, and 0.29% in the United States per 10  $\mu\text{g}/\text{m}^3$  increase in PM<sub>10</sub> concentration. PM<sub>10</sub> was associated with increased mortality in those aged 75 years and older and was associated with higher unemployment, suggesting that populations with a lower socio-economic status may be more susceptible to the effects of long-term exposure to air pollution on mortality.<sup>11</sup> Other studies such as the ESCALA (Estudio de Salud y Contaminación del Aire en Latinoamérica) study in Latin America, the Public Health and Air Pollution in Asia (PAPA) study, and the National Morbidity Mortality Air Pollution Study (NMMAPS) study in the U.S. also found increases in mortality per 10  $\mu\text{g}/\text{m}^3$  increase in PM<sub>10</sub> concentration of 0.77%, 0.55%, and 0.19% respectively.<sup>10</sup>

**Figure 3: Percentage change in all-cause mortality per 10  $\mu\text{g}/\text{m}^3$  increase in two-day moving average concentrations of PM<sub>10</sub> and PM<sub>2.5</sub><sup>12</sup>**



Rates of hospitalization in the U.S. for COPD in patients aged 65 and older are around 11.38% per year, with age-adjusted mortality across all ages at 39.7 per 100,000 U.S. residents.<sup>13</sup> The increased mortality risk in the U.S. was primarily driven by higher smoking rates before 1965. However, although cigarette smoking is the leading cause of COPD, a quarter of adults with COPD have never smoked. Conversely, mortality from COPD in China has fallen because of reduced levels of air pollution since 2013.<sup>6,7</sup>

**Figure 4: Relative risk (RR) of COPD mortality in China and the U.S., 1992-2017<sup>6</sup>**



## Conclusion

Current high levels of air pollution around the world are contributing to increased rates of chronic respiratory disease and impaired lung function in people of all ages. Numerous studies have shown that ambient air pollution is a leading cause of excess mortality across the world. Until such time as levels of air pollution are reduced in countries all over the world, insurers are likely to see rising rates of respiratory disorders and other non-communicable diseases at underwriting stage and increased claims for illness and resulting death claims.



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