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Democracy Dies in Darkness

Why you should protect your eyes when air pollution levels are high

When it comes to your vision, there are no safe levels of dirty air

By Marta Zaraska
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In 19th-century London, when Charles Dickens wrote that "the fog was heavy and dark," people were advised to wear special fog glasses while out in the smog to avoid "smarting eyes." Modern research shows such recommendations were onto something: Dirty air can ruin our eyesight.

It can lead to cataracts, glaucoma (the second-most-common cause of blindness), conjunctivitis, age-related macular degeneration and even up the risk of having to wear glasses. And while research shows that such effects are the most striking in heavily polluted cities in Asia, studies conducted in North America and Europe have found that even lower doses of air pollution can harm our eyes.

Studies have long found that air pollution is clearly bad for health — especially our lungs (think asthma) and cardiovascular systems (think heart attacks and strokes). However, research on how a dirty atmosphere can impact our eyes is only beginning to emerge. "Eye is an organ certainly being neglected," said Lina Mu, an epidemiologist at the University at Buffalo.

Our eyes are, in fact, particularly vulnerable to dirty air, said Paul Foster, an ophthalmic epidemiologist at University College London. For one, they are directly exposed to pollution in the air, which can lead to dry eye disease (when you don't have enough good quality tears to keep your eyes lubricated).

And two, the retina, the eye's light-sensitive layer at the back of the eye, has many blood vessels, making it acutely sensitive to pollution. "Anything that gets into the bloodstream will be circulating at very high concentrations in the back of the eye," Foster said.

One of the major vision disorders that studies connect to polluted air is glaucoma — a neurodegenerative disease in which the optic nerve at the back of the eye becomes damaged. Research shows that high exposure to fine particles found in pollution — larger ones, called PM10, and finer ones, PM2.5 , which come from sources that include cars and trucks, power plants, residential fireplaces and forest fires — significantly increases the risk of this particular disease.

In one large study, doubling the monthly average PM2.5 concentration in the air increased the risk of glaucoma by 66 percent.

The annual average level of PM2.5 in the United States is about 10.3 μg/m3 — low by world standards but about twice what the World Health Organization guidelines say is acceptable. (Some 97 percent of U.S. cities did not meet the WHO standard in 2021.) Many cities in Asia in particular struggle with much higher levels than that. In 2021, New Delhi registered an average annual PM2.5 concentration of 85 μg/m3.

Yet even significantly lower levels than that can lead to vision problems, glaucoma included.

A French study published in September showed that exposure to PM2.5 at concentrations below the E.U. recommendations of 25 μg/m3 may lead to accelerated thinning of the nerves that transmit visual signals from the retina to the brain, which is a key indicator of glaucoma.

According to Cécile Delcourt, epidemiologist at the National Institute for Health and Medical Research in France and the study's lead author, these results underscore that, when it comes to healthy vision, there are really no safe levels of air pollution.

Cataracts, too, are made worse by dirty air. A large British study conducted by Foster and his colleagues found that people who live in areas with the highest PM2.5 pollution have a 14 percent higher risk of needing surgery for a cataract — a disorder that clouds the eye's natural lens, making things appear more blurry and stripped of colors. Disturbingly, the areas with the highest pollution levels in that particular study were at levels below that of some U.S. cities, such as Chicago and Los Angeles

Under China's often-polluted skies, researchers calculated that fine particle pollution may be responsible for nearly a quarter of all age-related cataracts in the country.

China is also struggling with an epidemic of myopia, also known as nearsightedness, and dirty air may be partly to blame, experts said. While as many as 91 percent of Chinese high-schoolers are nearsighted, that number is a mere 13 percent in far less polluted Norway. Of course other lifestyle factors, including screen usage and outdoor time, might be at play here, too, and so can genetic differences.

A study in Taiwan found that the higher the presence of PM2.5 and nitrogen oxides (of which NO2 is one type) in the air, the higher the risk of myopia: For children living in places with particularly high levels of nitrogen oxides, the risk of nearsightedness more than doubles when compared with children living in the cleanest areas.

On the positive side, pollution-sapping greenery in a neighborhood has been associated with a lower risk of myopia among children. Admittedly, the effect is partly explained by the fact that parks tear children away from screens, which are an important risk factor for myopia.

While the research on air pollution and vision in humans is derived from observing health trends in groups — it would be unethical to submit people to pollutants and see what happens — studies on lab animals suggest that these effects are not just coincidence. For instance, when scientists had hamsters inhale high doses of PM2.5 twice a day, the animals developed myopia three weeks later.

Once such tiny particles of pollution get into the lungs, they are "relatively rapidly absorbed into the bloodstream," Foster said, "and that's where these fine particles start to have a more profound effect" on the animals, most importantly causing inflammation.

Laboratory experiments on human retinal cells in 2023 found that when such cells are exposed to particulate matter, inflammation goes up — which, in turn, has been associated with vision disorders such as glaucoma.

Animal studies also show that exposure to polluted air can damage DNA in the retina and cause premature death of neurons at the back of the eye.

One possible way to counteract dirty air's damaging effects on the eyes, Mu said, is to wear sunglasses, use lubricating eyedrops, wash hands often and avoid rubbing your eyes on days when air pollution levels are high, so as not to exacerbate any irritation. Amy Millen, also an epidemiologist at the University at Buffalo, suggested eating an antioxidant-rich diet (think plenty of fruits and vegetables).

The good news, Mu said, is that, compared with smoking or too much screen time, air pollution has a smaller impact on eyes. The bad news? "You can protect yourself from screen time; you can change your lifestyle, [but] air pollution is there, and you cannot avoid" it, she said.

This is why many experts argue that the best way to protect vision from dirty air will be to stop burning fossil fuels. "If we clean up the environment, there's a benefit for the individual as well as for the coming generations," Foster said.

Until then, fog glasses may not be such a bad idea.