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The Air Quality Index and how to use it, explained

8 things you should know about the number that measures bad air.

By Rebecca Leber | @rebleber | rebecca.leber@vox.com | Jun 28, 2023, 2:10pm EDT

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Worsening wildfires mean everyone should have a basic understanding of how to read and respond to the Air Quality Index. It's a good idea to reduce outdoor exercise on hazardous air days to cut down on exposure. | Kamil Krzaczynski/AFP via Getty Images

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It's not enough to trust the senses to know when it's a bad air day. Well before you can see or smell smoke, it can start wreaking havoc on the lungs.

That haze you can see and smell on a particularly polluted day is made of **ozone** and fine **particulate matter**.

Fine particulate matter, known as PM2.5 (the 2.5 microns describes its size, **30 times smaller** than the width of a human hair) can **embed** in the cells of the lung and the bloodstream, aggravating **inflammation**, **asthma**, **heart disease**, and **mental health**. And ozone causes similar damage. In the stratosphere, ozone blocks ultraviolet radiation from the sun, but at ground level it can **cause** shortness of breath and damage to respiratory tissue.

Both pollutants can affect the entire body in all stages of life: young and old, and even the developing fetus. They come from sources as varied as the tailpipe of a truck, your neighbor's barbecue, coal plant, or an incinerator. PM2.5 is capable of traveling thousands of miles across the world on the wind — taking, for instance, about five days to reach the US from China.

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The dose makes the poison; there is a difference between moderately bad air and really bad air. Public health experts recommend monitoring changes in air quality as often as you check the weather. But you should also know some basic facts to help you determine your own sensitivity to air pollution and the appropriate action to take.

What is the Air Quality Index?

The **Air Quality Index**, set by the Environmental Protection Agency, is your guide to how bad the air quality is outdoors. The data that goes into the Air Quality Index comes from **5,000 air monitors** across the country, including local, state, tribal, and federal reporting.

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There are actually two AQIs for air quality, one for particulate matter and one for ozone, but when you see just one AQI, you're looking at whatever pollutant is the higher of the two.

You can find the latest AQI on the EPA's **AirNow website** or by downloading its AirNow app. Weather apps are **often** using propriety data from a company called **BreezoMeter** to determine AQI and forecasts. These numbers are based on EPA monitoring but may not be identical to the EPA's AQI, though they should be in the same ballpark. Outside the US, air pollution monitoring can vary widely depending on the country, so AQIs reported around the world may also be pulling from a mix of computer modeling and satellite data.

There are some important drawbacks to the AQI. It tries to distill a lot of information into one datapoint, and it depends on air monitors often placed near cities and not close to industrial polluters. Since air pollution can vary widely even over short distances — **think a busy highway** versus a quiet, tree-lined road — the air could be worse if you're near a pollution source. Communities of color are systematically exposed to more pollution from industrial sources and transportation, and the AQI doesn't do a good job capturing that disparity.

Thousands of air quality monitors pull data from around the country to calculate the Air Quality Index. While the monitoring captures an accurate high-level view of pollution levels, it doesn't capture pollution that can vary widely block to block. | Hyoung Chang/Denver Post via Getty Images

Who really needs to pay attention to the AQI?

Ideally, everyone should monitor the AQI. EPA experts liken it to understanding the weather.

People have different sensitivities to air pollutants, just as people can have different temperatures they're comfortable at. They can even be more uncomfortable with one type of pollutant than another.

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But the EPA breaks out its recommendations for a general population group and a sensitive population. The **sensitive group** is actually quite large. If you have asthma or COPD, you fall in this category, but so do young children (under age 5), older adults (over 65), and pregnant people.

"The younger the child is, the faster their breathing, and so pound for pound, they are breathing more air pollution," said Lisa Patel, a Stanford professor of pediatrics and an executive director of the Medical Society Consortium on Climate and Health. "We use 5 as a cut-off for particular vulnerabilities because age 0-5 is a period of really rapid lung growth. And so exposure to those toxins so early is particularly concerning, but it's also concerning across the entire spectrum of ages."

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Even if you don't fall into one of the sensitive categories, an EPA official explained that the public should still "know their number." The AQI is based on large population studies, so it doesn't necessarily help you understand your individual risk. By monitoring the AQI regularly and paying close attention to any symptoms, you can get a feel for the level at which you should take proactive action.

What are the six level of air quality? And when should I be concerned?

The EPA breaks the Air Quality Index into a few categories with **different recommendations.**

- **Green (0–50):** The air is safe to breathe.
- **Yellow (51–100):** The air quality is considered moderate, except for the most sensitive groups.
- **Orange (101–150):** Sensitive groups should reduce heavy exertion outside or take more breaks, and people with asthma and heart disease should watch for symptoms. The rest of the population may be fine.
- **Red (151–200):** The air is unhealthy for everyone. Sensitive groups should avoid being active outdoors, while everyone else should reduce their time outdoors.
- **Purple (201–300):** The air is very unhealthy for everyone. Everyone should consider moving their activities inside.
- **Maroon (301 and above):** This is the highest level — hazardous — and anyone can be at risk. Everyone should avoid physical activity outdoors, and if you're sensitive, you should remain indoors.

Doctors and public health experts urge people to monitor any symptoms as pollution levels climb, especially once the AQI is in the orange and red range.

The symptoms to watch can vary. A surefire sign to take it easy (limiting activity outdoors and potentially seeking medical help) is shortness of breath. Coughing, discomfort, and tightness of the chest can all signal issues with breathing.

Other symptoms could be less obvious, throat irritation, fatigue, a stuffy nose or a headache. An EPA expert explained she feels a side stitch when exercising on a bad air day.

In infants, Patel suggests to look out for grunting noises, bobbing heads, and using chest muscles to breathe as warning signs. Kids who have asthma should have an asthma action plan set with a health provider on using an inhaler.

It's important to pay attention to these symptoms in both adults and children while regularly checking the AQI level at which you start to feel discomfort. Starting this now will help you in the future when you need to decide what precautions to take and when.

What are the precautions I should take outdoors, and when should I take action?

The AQI is most confusing when it falls into the yellow, orange, and red ranges.

If you are sensitive to air pollution, then you want to reduce your exercise and heavy exertion outside once the AQI hits orange. The entire population should start taking precautions when it is in the red territory. You might even want to reconsider spending extensive time outside at these higher levels, and don an N95 or KN95 mask if you do need to be outside (cloth masks will not protect you from PM2.5).

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It helps to think about reduction in terms of dosage. You can cut your time outside, your exertion level, or both. If you reduce a 30 minute walk to 15 minutes, you're cutting your exposure to the pollution by half. If you sit on your porch instead of going for a walk or run, you're also cutting down how much pollution you inhale.

When is air pollution at its worse?

The time of year, and even the time of day, can matter immensely for air quality.

Ozone is typically at its worst in warmer months, between April and October in the US. It needs sunlight to trigger its chemical reactions, so late afternoons and early evenings can be smoggier than the mornings. Emissions that come from the tailpipes of cars and burning fossil fuels interact to form ozone that can build up to dangerous concentrations depending on geography and weather patterns.

Particulate matter's worst months are usually peak wildfire season, so late summer and fall. Again, though, there are no strict rules here. Wildfires are no longer contained to predictable seasons due largely to **climate change**, as the East Coast experienced when Canadian wildfires caused smoggy extremes in early June. Other sources of PM2.5 include barbecues and fireworks, making July Fourth and the days that follow worse for air quality.

Tracey Holloway, an atmospheric scientist at the University of Wisconsin-Madison who works with NASA, also explained that, unlike ozone, PM2.5 "comes in different flavors." She explained, "There are some situations where PM2.5 is highest at night because it's trapped [an inversion where the ground is cooler], and there's some situations where PM2.5 is highest in the middle of the day because it's cooked up by the sun."

Though experts focus mostly on the two main pollutants of concern in air pollution, PM2.5 and ozone, there are other substances that can hitch a ride with this pollution. Patel, the pediatrician, said wildfire smoke is especially toxic. Burning trees can release more mercury in the air because of how the pollutant has settled on surfaces. And when fires hit houses and towns, they burn up plastics and petrochemicals, releasing more carcinogenic and metallic substances into the atmosphere.

One tip is to not dose yourself unnecessarily with pollution when air quality is bad. A hazardous air day is a poor time to fire up the barbecue or gas stove. You could swap out the gas appliance entirely for an induction burner. | Patrick T. Fallon/AFP via Getty Images

Should I be concerned indoors?

Staying indoors helps, but there are some additional actions to consider.

If you have central air conditioning or can access a building with air conditioning, that helps filter out pollutants. Also, HEPA air filters cut down on particulate matter and don't have to cost a lot. The University of Washington has a manual for building your own **low-cost air filter for roughly $20**, which can dramatically lower fine particles.

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Since you're getting a hefty dose of air pollution from the outdoors, it's even more important not to expose yourself unnecessarily inside. Former Director of the Center for Climate, Health, and the Global Environment at Harvard T.H. Chan School of Public Health and pediatrician Aaron Bernstein said people do this in ways they don't realize. They might idle their cars in attached garages, or use fragranced and ozone-forming products, or run wood- or gas-burning stoves and fireplaces that pollute indoor air.

What can my community do to reduce air pollution?

The No. 1 action we can take for better air is addressing the root cause, not just the symptoms. After all, not everyone has control over their outdoor activities, and some communities and outdoor workers face **astronomically higher risk from pollution** than others. White Americans contribute **more to air pollution** through their consumption of goods and services, yet Black and Hispanic Americans tend to live in neighborhoods **with lower air quality**.

One of the challenges in tackling climate change is that the carbon we're releasing now will stick around in the atmosphere for hundreds of years. That's fortunately not the case with particulate matter and ozone. They settle in a matter of days, so air can clear almost immediately once we address the sources of pollution. The world experienced **how fast the air can improve** when road and air travel came to sudden standstill early in the Covid-19 pandemic.

"A lot of air pollution comes from controllable sources," Holloway said. "When we implement changes to our transportation, industries, energy systems, and roadways, all of those can immediately improve our air quality. Certainly, we can't just make a policy change and have wildfires go away. But for many other sources of air pollution, there are a lot of available technologies to make the air cleaner."

Despite worsening wildfires, air quality has on the whole grown cleaner, especially within the United States over the last 40 years, as states have reduced major industrial sources of smog. Environmental regulations have worked as intended to clean up the worst polluters.

"We have already made huge improvements in having cleaner vehicles and trucks, cleaner power plants, and cleaner industrial facilities," said Holloway. "And these have been deliberate choices that we've made." Holloway believes "this isn't a hopeless situation" as long as society moves to tackling the sources of the problem.

What other resources are out there?

- The basic resources everyone should know about: the EPA **AirNow website** and AirNow app. These have information you need about the AQI level and the forecast.
- The EPA **Fire and Smoke** map has much more detailed information by zip code on PM2.5 coming from wildfires, drawing from a larger range of sources than the basic AQI.
- The EPA's guidance for **schools**.
- The Centers for Disease Control and Prevention's guidance on what to do to protect yourself from wildfire smoke, **broken down by vulnerable groups.**
- The EPA also tracks pollution sources across a broad range in its **EJScreen map.** ProPublica launched its own impressive database of **cancer-causing air pollution** by zip code across the US.
- A resource for monitoring **air quality around the world**.

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