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Air Pollution, Climate, and Heart Disease

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Two decades of research have shown that air pollution can trigger heart attacks, strokes, and irregular heart rhythms, particularly in people already at risk for these conditions. Several reviews of these studies, including 2 American Heart Association scientific statements, describe the scientific findings and conclude that air pollution poses a risk to heart health.¹⁻⁴ You can help protect your health and the health of your family, neighbors, and community from risk caused by air pollution, including the risk to your cardiovascular health. The Environmental Protection Agency (EPA), American Heart Association, American Stroke Association, and American College of Cardiology have published a concise leaflet on “Heart Disease, Stroke and Outdoor Air Pollution” that is available online (www.epa.gov/airnow/heart_flyer-1-28-10-final.pdf).⁵ This article provides advice for patients based partially on this leaflet and the EPA website <http://airnow.gov/>.⁶ General advice on air pollution and the heart is also available on the EPA website <http://www.epa.gov/greenheart/>.⁷

What Is Air Pollution?

Air pollution is a mixture of gases and particles that come from manmade and natural sources. For heart disease and stroke, very small particles that go down into the airways seem to be the most important form of air pollution for triggering these events, particularly in those at high risk. These particles, measured and reported by the EPA as PM_{2.5}, come from cars and trucks, power plants, industrial boilers, other industrial sources, and wildfires. Globally, cigarette smoking and wood- or biomass-burning stoves used for cooking⁸ and heating are major sources of indoor particle pollution.

Ground-level ozone, known for years to worsen lung disease, may also trigger heart attacks and strokes in susceptible people. It is formed when pollutant gases emitted by cars and trucks, power plants, industrial boilers, refineries, chemical plants, and other sources react chemically in the presence of sunlight and heat.

Are You at Increased Risk?

For most people, air pollution poses only a small risk as a trigger for heart attacks, strokes, or irregular heart

rhythm. However, some people are at higher risk, including those who have had a heart attack or angioplasty or those who have angina, heart failure, some types of heart rhythm problems, or diabetes mellitus. You may also be at greater risk from air pollution if you have known risk factors for heart disease: if you smoke cigarettes, if you have high blood pressure or high blood cholesterol, if you have a family history of stroke or early heart disease (father or brother diagnosed before 55 years of age; mother or sister diagnosed before 65 years of age), or if you are more than 65 years old.

Does Extreme Weather Increase Risk?

Studies suggest that hot and cold weather extremes may increase the risk of heart attacks or death related to heart attacks (<http://www.niehs.nih.gov/research/programs/geh/climatechange/>).⁹ Weather extremes and high pollution sometimes occur together and may be particularly dangerous for those at risk.⁴ Especially if air conditioning is not available, very hot weather is dangerous for those with heart disease, the elderly, and persons

The information contained in this *Circulation* Cardiology Patient Page is not a substitute for medical advice, and the American Heart Association recommends consultation with your doctor or healthcare professional.

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taking many cardiovascular medications that limit a person's ability to cope with heat.

What Can You Do to Protect Yourself?

- Reduce your overall risk of heart disease or stroke. You can take steps on your own and with advice from your healthcare provider to reduce your risk of heart disease and, if you have had a clinical event, to reduce your risk of a recurrent heart attack, stroke, or irregular heart rhythm. It is likely that reducing your overall risk of recurrent clinical events will simultaneously reduce the risk of air pollution–triggered clinical events. Reducing risk includes healthy lifestyle choices (ie, stopping cigarette smoking, controlling your blood pressure and cholesterol, following advice on weight control and exercise). You can learn more from the US Department of Health and Human Services about lowering risk factors for heart disease and stroke at www.millionhearts.hhs.gov.¹⁰
- Know when and where particle and ozone pollution levels may be unhealthy. Particle pollution is sometimes visible as haze, often brown, and reduces visibility; high ozone levels combined with particles can be seen as smog and at very high levels can irritate the eyes and throat. However, pollution may not be felt or seen, even though it may be at risky levels.

Locally, particle levels can be high near busy roads in urban areas (especially during rush hour), near some factories, and where there are wildfires. However, particle pollution, including emissions from high smoke stacks, is often transported long distances without respecting state boundaries.

You can find air pollution forecasts on local or national television, radio, or newspaper reports and on the Weather Channel and EPA Web sites (<http://www.weather.com/>¹¹ and <http://airnow.gov/>,⁶ respectively). The reports use the Air Quality Index, or AQI, a color

scale, to tell you how clean or polluted the air is on a given day, associated levels of health concerns for healthy and sensitive people, and corresponding health messages (Figure).⁶ For many cities, AQI forecasts are available for the next day.

You can sign up for e-mail notification at www.enviroflash.info.¹² This free service will alert you when your local air quality reaches levels of concern and can help you plan your activities for the day:

- Plan your activities when and where pollution levels are lower.
- Change your activity level if pollution levels are high by limiting time outdoors and in areas where pollution may be highest. If you take it easier and walk rather than jog, the amount of pollution you breathe will be reduced. Moving your activity indoors is helpful in reducing ozone exposures, especially if your windows are shut and you have the air conditioner on, but other pollutants can come into the home, albeit at lower levels.
- Avoid exercising near busy roads and at times of day when pollution is high.
- People may choose to take steps to protect themselves as individuals or their families by using masks for respiratory protection or by using an air cleaner. These approaches have not been proven to help protect against outdoor air pollution–associated risk of heart disease or stroke. Typical masks do not provide good protection against the small PM_{2.5} particles. Individual typical air-cleaning devices that are free-standing units can lower particle (not gas) air pollution levels only within small spaces or single rooms (with doors and windows closed) and not whole households. Air-cleaning devices have not been proven to protect against the adverse effects of indoor cigarette smoke (which emits both particles and gases) on heart or lung disease. Yet, under air pollution emergencies, for example, those associated

with wildfires, the use of personal masks and indoor air-cleaning devices could be advised by public health officials as part of more comprehensive recommendations to reduce exposure (http://oehha.ca.gov/air/risk_assess/wildfirev8.pdf).¹³ When masks are used, they should be N95 or P100 mask respirators that effectively remove very small air pollution particles.

What Can You Do to Protect Your Family, Neighbors, and Community?

- Family ties and neighborhood ties matter. Not all people have access to the World Wide Web or are technologically plugged in. Some people may not listen to or read the news and may not be able to act even if they hear about pollution episodes or extreme weather. Power outages may shut off air conditioners or elevators. Elderly people or people with disabilities may not know to turn the heat up if it is cold or to turn on the air conditioner if it is hot, or they may not be able to afford fuel or air conditioning. They may insist on sheltering in place rather than going to community cooling or warming centers for fear of losing their right to live at home, for fear of looting, or because of the confusion that comes with change.
- Neighbors, friends, families, and local community organizations can save lives by offering vulnerable people help they can trust: shelter, air conditioning, or water during a heat wave or a safe, warm room and heat during a cold patch. Klinenberg¹⁴ reports that during the July 1995 heat wave that killed more than 700 people in Chicago, IL, the community of North Lawndale experienced a death rate of 40 per 100 000 persons, whereas neighboring South Lawndale had a rate of fewer than 4 per 100 000 residents. Both communities were poor and had similar numbers of elderly residents, but the people of South Lawndale had more neigh-



Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health warnings of emergency conditions. The entire population is more likely to be affected.
Hazardous	301 to 500	Health alert: everyone may experience more serious health effects.

Figure. Air Quality Index. Reprinted with permission from the U.S. Environmental Protection Agency AirNow Program. Authorization for this adaptation has been obtained both from the owner of the copyright in the original work and from the owner of copyright in the translation or adaptation.

borhood supports that they could trust and turn to during this extreme weather episode. There were fewer abandoned houses; the streets were safer and busier with commerce and public activity, making it more likely that seniors would feel safe enough to leave the house if they were physically able to do so. Neighborhood factors also influence what individual choices are available when air pollution levels are elevated, which often happens at the same time as heat waves.

- Stay informed about efforts to improve air quality in your community and in your nation. Community regulation of air pollutants complements steps by individuals with heart disease to reduce their exposures when pollution levels are high. The mandate of the Clean Air Act is to protect health for the general population and sensitive groups in the population, including people with heart disease, with an adequate margin of safety. The National Ambient Air Quality Standards for each of the main or “criteria” pollutants

(ozone, particulate matter, carbon monoxide, sulfur oxides, nitrogen oxides, and lead) result from a rigorous process (1) to comprehensively review the scientific evidence for pollution health effects in the Integrated Science Assessment (www.epa.gov/ncea/isa/),¹⁵ (2) to consider how much risk there is for each pollutant, and (3) to assess how much the risk can be reduced by changing the standard. A public comment period during which public hearings are held precedes rule making.

Air Pollution, Heart Disease, and Stroke: A Global Problem

Because of air quality regulation, particle pollution levels have been decreasing, and this decline has led to a meaningful (more than half a year) increase in life expectancy,¹⁶ contributing to the substantial reduction in cardiovascular mortality over the last 5 decades.¹⁷ This is not the case in many other parts of the world, where air pollution and pollution-associated

cardiovascular mortality¹⁸ have been increasing. The mega-cities of Asia, Africa, and Latin America are of particular concern because air pollution levels are rising in many, driven by industrialization and rapidly growing vehicle fleets. The World Health Organization estimated that fine particles were the 13th leading cause of worldwide mortality, contributing to about 800 000 premature deaths per year.² Worldwide indoor solid fuel air pollution ranked fourth and ambient particulate air pollution ranked ninth, considering 67 risk factors contributing to the global burden of disease in 2010.¹⁹ Even in high-income North America, ambient air pollution was ranked the 14th contributor to the burden of disease, following risk factors such as tobacco smoking, obesity, high blood pressure, high glucose, alcohol use, drug use, high cholesterol, and dietary behaviors, including diets high in sodium, low in fruits and vegetables, and high in processed meats.¹⁹ Thus, air pollution remains a critical global health problem.

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None.

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