

US EPA ARCHIVE DOCUMENT

GROUND-LEVEL OZONE AND HEALTH

What is Ozone?

- Ozone is found in two regions of the Earth's atmosphere – at ground level and in the upper regions of the atmosphere. Both types of ozone have the same chemical composition (O₃).
- While [upper atmospheric ozone](#) forms a protective layer from the sun's harmful rays, ground-level ozone is the main component of smog.
- [Ground-level ozone](#) is not emitted directly into the air, but forms through a reaction of nitrogen oxides (NO_x), volatile organic compounds (VOCs), carbon monoxide (CO) and methane (CH₄) in the presence of sunlight.
- Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are the major man-made sources of NO_x and VOCs.
- Because sunlight and hot weather accelerate its formation, ozone is mainly a summertime air pollutant. Both urban and rural areas can have high ozone levels, often due to transport of ozone or its precursors from hundreds of miles away.

Ozone and Public Health

- Exposures to ozone can:
 - Reduce lung function, making it more difficult for people to breathe as deeply and vigorously as normal,
 - Irritate the airways, causing coughing, sore or scratchy throat, pain when taking a deep breath and shortness of breath,
 - Inflammation and damage the airways,
 - Increase frequency of asthma attacks,
 - Increase susceptibility to respiratory infection, and
 - Aggravate chronic lung diseases such as asthma, emphysema and bronchitis.
- In some people, these effects can lead to:
 - Increased medication use among asthmatics,
 - More frequent doctors visits,
 - School absences,
 - Increased emergency room visits and hospital admissions, and
 - Increased risk of premature death in people with heart and lung disease.
- Groups that are at greater risk from ozone include:
 - People with lung disease, especially children with asthma.
 - Children and older adults.
 - People who are active outside, especially children and people who work outdoors.



Review of Science: Public Health

- Scientific evidence indicates that adverse public health effects occur following exposure to ozone, particularly in children and adults with lung disease.
- Breathing air containing ozone can reduce lung function and inflame airways, which can increase respiratory symptoms and aggravate asthma or other lung diseases. Ozone exposure also has been associated with increased susceptibility to respiratory infections, medication use, doctor visits, and emergency department visits and hospital admissions for individuals with lung disease.
- Ozone exposure also increases the risk of premature death from heart or lung disease.
- Children are at increased risk from exposure to ozone because their lungs are still developing and they are more likely to be active outdoors, which increases their exposure.

Ozone and Health Risks

How does ozone affect health?

Scientists have been studying the effects of ozone on human health for many years. So far, they have found that ozone primarily affects the respiratory system. Roughly one out of three people in the U.S. is at risk of experiencing ozone-related health effects.

Ozone can irritate your respiratory system

When this happens, you might start coughing, feel an irritation in your throat, and/or experience an uncomfortable sensation in your chest. These symptoms can last for a few hours after ozone exposure and may even become painful.

Ozone can reduce lung function

When scientists refer to “lung function,” they mean the volume of air that you draw in when you take a full breath and the speed at which you are able to blow it out.

Ozone may make it more difficult for you to breathe as deeply and vigorously as you normally would. When this happens, you might notice that breathing starts to feel uncomfortable. If you are exercising or working outdoors, you may notice that you are taking more rapid and shallow breaths than normal. Reduced lung function can be a particular problem for outdoor workers, competitive athletes and others who exercise outdoors.

Ozone can inflame and damage the lining of the lung

Some scientists have compared ozone-caused lung damage to a sunburn on the skin. Ozone damages the cells that line the air spaces in the lung. Within a few days, the damaged cells are replaced and the old cells are shed – much in the way skin peels after a sunburn. If this kind of damage occurs repeatedly, it may lead to permanent damage to your lungs that could cause a lower quality of life.



Ozone can make asthma symptoms worse

When ozone levels are high, more asthmatics have attacks that require a doctor's attention or the use of additional medication. One reason this happens is that ozone makes people more sensitive to allergens, which are common triggers for asthma attacks. Some of the common asthma triggers are dust mites, cockroaches, pets, mold and pollen. Asthmatics may also be more severely affected by ozone-induced respiratory irritation and reduced lung function than non-asthmatics.

Ozone can cause other health problems

Ozone can aggravate chronic lung diseases, such as emphysema and bronchitis. Studies suggest that ozone also may reduce the immune system's ability to fight off bacterial infections in the respiratory system.

All of these effects result in increased medication use, missed school and work, increased doctor and emergency department visits, increased hospital admissions and premature mortality.

Scientists are concerned that repeated short-term damage from ozone exposure may permanently injure the lung. For example, repeated ozone damage to the developing lungs of children may reduce their lung function when they are adults. In addition, ozone exposure may speed up the decline in lung function that occurs as a natural result of aging.

National Institute of Environmental Health Sciences

The NIEHS published a report on April 22, 2010 titled [*A Human Health Perspective on Climate Change: A Report Outlining the Research Needs on the Human Health Effects of Climate Change*](#). Chapter one of this report addresses asthma, respiratory allergies and airway diseases which ground-level ozone is shown to adversely affect. In the early 1990s, the United States attributed health care costs of \$11 billion to all respiratory disease with an estimated loss of 3 million workdays and 10 million schooldays. Asthma is the second leading cause of chronic illness among children and is rapidly rising among children less than five years of age; however, the prevalence of asthma is highest among adults.