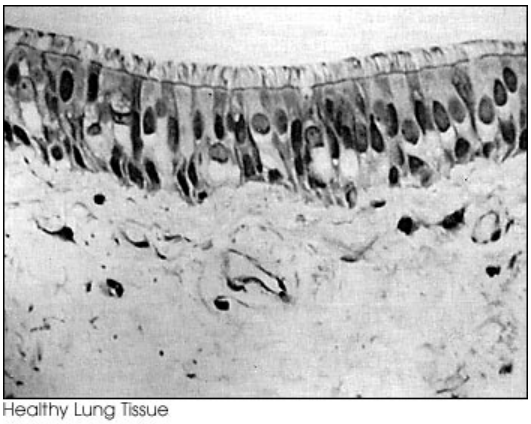
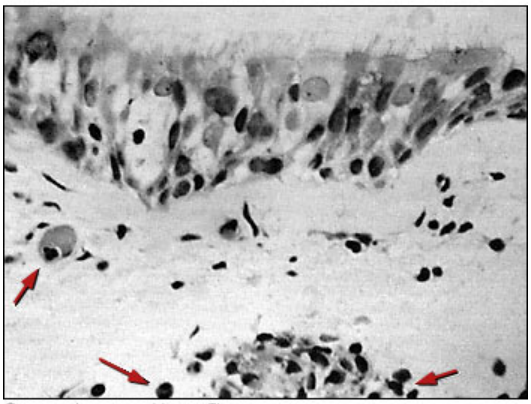
The Ozone We Breathe

Ozone's Effects on Human Health

Shortness of breath, dry cough or pain when taking a deep breath, tightness of the chest, wheezing, and sometimes even nausea are common responses to ozone. Ozone reacts with molecules in the lining of our airways. Chemical bonds break and reform in different ways with the addition of oxygen atoms (the process of oxidation) from ozone, and this causes acute inflammation. The lining of our airways loses some of its ability to serve as a protective barrier to microbes, toxic chemicals, and allergens. Our airways respond by covering the affected areas with fluid and by contracting muscles. Breathing becomes more difficult.



Healthy Lung Tissue



Ozone-damaged Lung Tissue

Microscopic views of human lung tissue (epithelium, or lining) show damage resulting from exposure to relatively low levels of ozone. In the control image (upper) from the lung of a person exposed only to air, the tiny cilia that clear the lungs of mucus appear along the top of the image in a neat and regular row. In the lung exposed to 20 ppb of ozone added to the air for four hours during moderate exercise, many cilia appear missing and others appear misshapen. Arrows point to tiny bodies called neutrophils in the ozone-exposed subject. The presence of neutrophils indicates inflammation. Magnification: x400. (Micrographs courtesy of the American Thoracic Society, from *American Review of Respiratory Diseases,* Vol. 148, 1993, Robert Aris et al., pp. 1368-1369.)

The National Institute of Environmental Health Sciences (NIEHS) at the National Institutes of Health reports that in controlled tests, a 5 to 10 percent reduction in lung capacity occurred in volunteers

"Ozone triggers asthma and may aggravate other respiratory illnesses such as pneumonia and bronchitis."

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engaged in moderate exercise for 6.5 hours at just 80 ppb (National Institutes of Health 2001), a level commonly reached during warm weather in many parts of the world. Ozone also triggers asthma and may aggravate other respiratory illnesses such as pneumonia and bronchitis. Ozone concentrations can make the small bands of muscles that help control breathing more sensitive to dry air, cold or dust, so ozone exposure may increase allergic responses in susceptible people.

While the effects of acute, short-term episodes of ozone exposure are reversible, the human body's response to long-term exposure may not be reversible. Exposure to ozone at levels we commonly encounter in many of our own communities permanently scars the lungs of experimental animals, causing long-term impairment of lung capacity, or the volume of air that can be expelled from fully inflated lungs. Ozone may have similar effects on human lungs. Studies in animals also suggest that ozone may reduce the human immune system's ability to fight bacterial infections in the respiratory system.

Ozone damage to people can occur without any noticeable signs. Even when initial symptoms appear, they can disappear while ozone continues to cause harm. Otherwise healthy people can expect to experience acute but reversible effects if they exercise regularly outdoors when ozone levels are high. The NIEHS considers such people to be especially susceptible as a group.

Children's vulnerability to ozone's ill effects provokes great concern among health professionals for several reasons. One reason is that children's respiratory defenses have not reached their full capability. Another is that children breathe more air per pound of body weight than adults so they take in more ozone per pound of body weight than adults do. Children are also in a phase of rapid growth, and their metabolic rates are higher than adult rates tend to be. Furthermore, children generally exercise outdoors more than adults do. According to a recent study conducted by researchers at the University of Southern California Keck School of Medicine with fourth grade school children, each increase of 20 ppb in ozone is associated with a 63 percent school absence rate increase for illness. The same increase in ozone concentration is associated with an 83 percent increase for respiratory illness. (Gilliland 2001) 20 ppb represents a relatively small and common increase in ozone concentration.

Responses to ozone pollution vary from one individual to another, sometimes for reasons we don't yet understand. The U.S. Environmental Protection Agency (EPA) estimates that 5 to 20 percent of the total U.S. population has an unexplained greater susceptibility (American Lung Association 2000)

The EPA has designated ozone one of six "criteria air pollutants" and therefore a pollutant that must be kept in check. Yet few state governments have enforced regulations designed to bring ozone air pollution under control. Tropospheric ozone levels in the more polluted regions of the Northern Hemisphere appear to be rising at about 1 percent per year (Turco 1997) The American Lung Association reports that scientists' estimates of the annual number of deaths in the United States associated with air pollution range from 50,000 to 100,000. (American Lung Association 2001) While another form of air pollution, particulate matter, is the one most prominently linked to premature death, ozone pollution plays an important role as well in this threat to human health and well-being.

next: Ozone's Effects on Plants
back: Introduction