

APPENDIX F

Health and Ozone

Ozone and Your Health:

- Ground-level ozone – the primary component of smog – is formed in the atmosphere on hot, sunny days. The main ingredients of ozone come from cars, trucks, power plants, refineries and other large industrial facilities, and some natural sources.
- When inhaled, even at very low levels, ozone can:
 - cause acute respiratory problems;
 - aggravate asthma;
 - cause significant temporary decreases in lung capacity of 15 to over 20 percent in some healthy adults;
 - cause inflammation of lung tissue;
 - lead to hospital admissions and emergency room visits [10 to 20 percent of all summertime respiratory-related hospital visits in the northeastern U.S. are associated with ozone pollution]; and
 - impair the body's immune system defenses, making people more susceptible to respiratory illnesses, including bronchitis and pneumonia
- The Clean Air Act requires communities with air pollution levels that violate – or contribute to the violations of – the National Ambient Air Quality Standard (NAAQS) for ozone to
 - 1) be designated as “nonattainment,”
 - 2) have an EPA-approved plan in place to correct the problem, and
 - 3) attain each standard by specific dates.
- In 1997, after reviewing the scientific data, EPA changed the way it measured ground-level ozone to better protect human health. The new standard measures ozone levels over 8-hour periods.
- In addition to working with areas that are participating in Early Action Compacts, EPA is also working with local governments, States and Tribes that are not participating in an early action compact to develop an implementation strategy for the 8-hour ozone standard.

Ozone: A Big Pollution Problem for All of Us.

Too much ozone in the air we breathe can be harmful to people who work or exercise outdoors regularly, anyone with respiratory difficulties, and especially our children. The most common symptom that people have when exposed to ozone while exercising is pain when taking a deep breath. Long-term effects may include reduced lung function and scarring of lung tissue.



Children are at greater risk for ozone-related respiratory problems because their lungs are still developing, they breathe more rapidly, and they play outside during the afternoons when ozone is worse. They inhale more pollution per pound of body weight than adults do. Additionally, anyone suffering from lung disease has even more trouble breathing when the air is polluted with high levels of ozone. Prolonged exposure, even to low levels of ozone, can reduce a healthy adult's lung function by 15 to 20%.

What Causes Ground-Level Ozone?

Ground-level ozone is created when a mixture of common air pollutants react in the heat and strong sunlight, becoming a big concern from May through September. The main ozone-causing pollutants are volatile organic compounds (VOCs) and nitrogen oxides (NOx). They are found in fumes from vehicles and boats, as well as from power plants. Motor vehicles account for about 30-40% of the ozone-causing pollutants in the Washington and Baltimore areas. Other pollution sources are gasoline vapors, oil-based paints, and lawn and garden equipment.

Every summer gasoline-powered lawn and garden equipment spew huge amounts of VOCs, making them second in our area behind cars and trucks as the cause of ozone smog.



Particles: Particle Pollution— What Is It and Where Does It Come From?

"Particles" or "particulate matter" are terms used to describe the mixture of solid particles and liquid droplets in the air we all breathe. Unlike ozone, particles are not a seasonal pollutant — high readings can occur any time of the year. The size of the particles is directly linked to their potential for causing health problems. Small particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into your lungs, and some may even get into your bloodstream. Some particles go directly into the air and come from a variety of sources such as motor vehicles, utilities, construction sites, and wood burning. Other particles may be formed in the air by chemical reactions when gases from burning fuels react with sunlight and water vapor.



What Are The Health Risks?

Particle exposure can lead to a variety of health problems. Numerous studies link particle levels to increased hospital admissions and emergency room visits -- and even to death from heart or lung diseases. Both long- and short-term exposure to particles have been linked to health problems.

- ▶ When exposed to unhealthy levels of particles, children, the elderly, and people with existing heart or lung diseases are at increased risk of hospitalization and early death.
- ▶ Particles can increase susceptibility to respiratory infections and can aggravate existing respiratory diseases causing more doctor visits and use of medication.
- ▶ Health problems for sensitive people can get worse if they are exposed to high levels of particles several days in a row.



Be a Part of the Solution

We can all make a difference in improving the region's air quality. Clean Air Partners, the public-private partnership which sponsors Air Quality Action Days, is hoping that everyone will make a small effort to reduce air pollution. Try ridesharing, refueling after dark, or bringing your lunch to work instead of going out to eat. Every little bit helps. Whenever you hear that it is an Air Quality Code Red or Code Orange day consult the Air Quality Action Guide on the pamphlet for ways you can reduce air pollution and protect your health.

Become an Air Quality Action Day participant. Urge your employer to contact Clean Air Partners for further information.

Resources

www.air-watch.net
www.mwcog.org
www.mde.state.md.us
www.epa.gov/airnow

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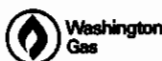


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**If we do our share,
we can breathe cleaner air!**

This region has several days each year when air pollution is poor. On "Air Quality Action Days" citizens are urged to take action to protect their health and also to reduce their pollution-causing activities.

When you hear that it is a Code Red or Code Orange Day, use the Action Guide below, the air is unhealthy!

**AIR
QUALITY
ACTION
DAYS**

Air Quality Action Guide

AIR QUALITY		RECOMMENDED ACTION
CODE PURPLE	Very Unhealthy	During Code Purple: - People with respiratory or heart ailments, children and the elderly should avoid outdoor physical activities. - People who must travel should be urged to leave vehicles running only when absolutely necessary. - Everyone is strongly urged to take all of the following steps:
CODE RED	Unhealthy	
CODE ORANGE	Unhealthy for Sensitive Groups	The following people should limit prolonged outdoor activities: - Children and adults who experience difficulty breathing outdoors. - Those with respiratory and heart ailments. All residents are urged to: - Limit driving and refuel cars after dusk. - Avoid using aerosol products. - Share a ride, telework from home, use transit, or drive only the best maintained, most fuel-efficient vehicles.
CODE YELLOW	Moderate	Residents should: - Consolidate trips and errands. - Limit car idling when possible. - Conserve electricity and set air conditioners to 78° F.
CODE GREEN	Good	Residents should try to: - Carpool, use public transit, bike or walk. - Keep cars and boats tuned. - Use environmentally friendly paints and cleaning products.



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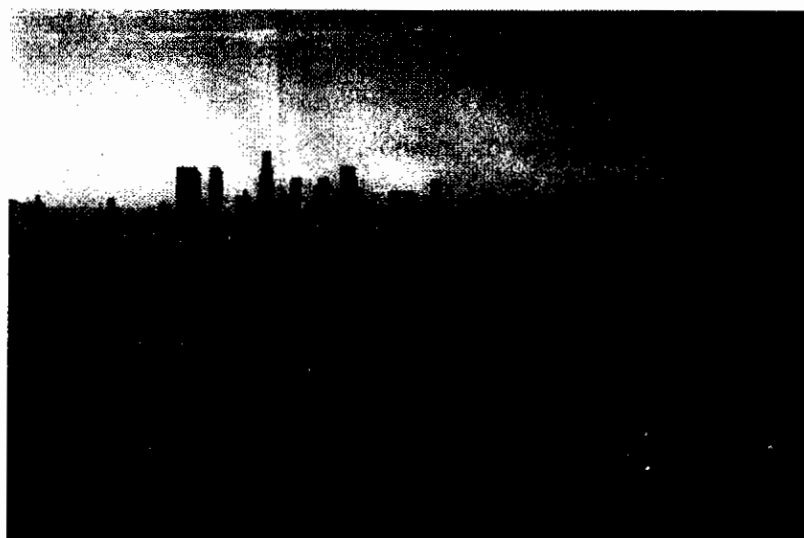


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Smog -- Who Does It Hurt?



What You Need to Know About Ozone and Your Health



On a hot, smoggy summer day, have you ever wondered: Is the air safe to breathe? Should I be concerned about going outside?

In fact, breathing smoggy air can be hazardous because smog contains ozone, a pollutant that can harm our health when there are elevated levels in the air we breathe. This publication will tell you what kinds of health effects ozone can cause, when you should be concerned, and what you can do to avoid dangerous exposures.

What is ozone?

Ozone is an odorless, colorless gas composed of three atoms of oxygen. Ozone occurs both in the Earth's upper atmosphere and at ground level. Ozone can be good or bad, depending on where it is found:

■ **Good Ozone.** Ozone occurs naturally in the Earth's upper atmosphere-10 to 30 miles above the Earth's surface-where it forms a protective layer that shields us from the sun's harmful ultraviolet rays. This "good" ozone is gradually being destroyed by manmade chemicals. An area where ozone has been most significantly depleted-for example, over the North or South pole-is sometimes called a "hole in the ozone."

■ **Bad Ozone.** In the Earth's lower atmosphere, near ground level, ozone is formed when pollutants emitted by cars, power plants, industrial boilers,

refineries, chemical plants, and other sources react chemically in the presence of sunlight.

The booklet *Ozone: Good Up High, Bad Nearby*, which can be found on the web at <http://www.epa.gov/oar/oaqps/gooduphigh>, contains additional information about both good and bad ozone.

This publication, *Smog-Who Does It Hurt?*, focuses on bad ozone—that is, ozone that occurs at ground level and can affect the health of people who breathe it.



Children and adults of all ages who are active outdoors are at risk from ozone exposure.

Should I be concerned about exposure to ground-level ozone?

That depends on who you are and how much ozone is in the air. Most people only have to worry about ozone exposure when ground-level concentrations reach

high levels. In many U.S. communities, this can happen frequently during the summer months. In general, as ground-level ozone concentrations increase, more and more people experience health effects, the effects become more serious, and more people are admitted to the hospital for respiratory problems. When ozone levels are very high, *everyone* should be concerned about ozone exposure.

Scientists have found that about one out of every three people in the United States is at a higher risk of experiencing ozone-related health effects (see "Who is most at risk from ozone?"). If you are a member of a "sensitive group," you should pay special attention to ozone levels in your area. This publication describes several tools that the U.S. Environmental Protection Agency (EPA), in partnership with State and local agencies, has developed to inform the public about local ozone levels. These tools provide the information you need to decide whether ozone levels on any particular day may be harmful to you. When ozone concentrations reach unhealthy levels, you can take simple precautions (described in "What can I do to avoid unhealthy exposure to ozone?") to protect your health.

How might ozone affect my health?

Scientists have been studying the effects of ozone on human health for many years. So far, they have found that ozone can cause several types of short-term health effects in the lungs:

- **Ozone can irritate the 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 can make it more difficult for you to breathe as deeply and vigorously as you normally would. When this happens, you may 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 other people who exercise outdoors.

■ **Ozone can aggravate asthma.** When ozone levels are high, more asthmatics have asthma 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 the most common triggers for asthma attacks. (Allergens come from dust mites, cockroaches, pets, fungus, and pollen.) Also, asthmatics are more severely affected by the reduced lung function and irritation that ozone causes in the respiratory system.

■ **Ozone can inflame and damage the lining of the lung.** Some scientists have compared ozone's effect on the lining of the lung to the effect of 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 that skin peels after a sunburn. If this kind of damage occurs repeatedly, the lung may change permanently in a way that could cause long-term health effects and a lower quality of life.

■ **Scientists suspect that ozone may have other effects on people's health.** Ozone may aggravate chronic lung diseases, such as emphysema and bronchitis. Also, studies in animals suggest that ozone may reduce the immune system's ability to fight off bacterial infections in the respiratory system.

Most of these effects are considered to be short-term effects because they eventually cease once the individual is no longer exposed to elevated levels of ozone. However, scientists are concerned that repeated short-term damage from ozone exposure may permanently injure the lung. For example, repeated ozone impacts on the developing lungs of children may lead to reduced lung function as adults. Also, ozone exposure may speed up the decline in lung function that occurs as a natural result of the aging process. Research is underway to help us better understand the possible long-term effects of ozone exposure.

Who is most at risk from ozone?

Four groups of people, described below, are particularly sensitive to ozone. These groups become sensitive to ozone when they are active outdoors, because physical activity (such as jogging or outdoor work) causes people to breathe faster and more deeply. During activity, ozone penetrates deeper into the parts of the lungs that are more vulnerable to injury. Sensitive groups include:

■ **Children.** Active children are the group at highest risk from ozone exposure. Such children often spend a large part of their summer vacation outdoors,

engaged in vigorous activities either in their neighborhood or at summer camp. Children are also more likely to have asthma or other respiratory illnesses. Asthma is the most common chronic disease for children and may be aggravated by ozone exposure.

■ **Adults who are active outdoors.** Healthy adults of all ages who exercise or work vigorously outdoors are considered a "sensitive group" because they have a higher level of exposure to ozone than people who are less active outdoors.

■ **People with respiratory diseases,** such as asthma. There is no evidence that ozone causes asthma or other chronic respiratory disease, but these diseases do make the lungs more vulnerable to the effects of ozone. Thus, individuals with these conditions will generally experience the effects of ozone earlier and at lower levels than less sensitive individuals.

■ **People with unusual susceptibility to ozone.** Scientists don't yet know why, but some healthy people are simply more sensitive to ozone than others. These individuals may experience more health effects from ozone exposure than the average person.

Scientists have studied other groups to find out whether they are at increased risk from ozone. So far there is little evidence to suggest that either the elderly or people with heart disease have heightened sensitivity to ozone. However, like other adults, elderly people will be at higher risk from ozone exposure if they suffer from respiratory disease, are active outdoors, or are unusually susceptible to ozone as described above.

How can I tell if I am being affected by ozone?

Often, people exposed to ozone experience recognizable symptoms, including coughing, irritation in the airways, rapid or shallow breathing, and discomfort when breathing or general discomfort in the chest. People with asthma may experience asthma attacks. When ozone levels are higher than normal, any of these symptoms may indicate that you should minimize the time spent outdoors, or at least reduce your activity level, to protect your health until ozone levels decline.

Ozone damage also can occur without any noticeable signs. Sometimes there are no symptoms, or sometimes they are too subtle to notice. People who live in areas where ozone levels are frequently high may find that their initial symptoms of ozone exposure go away over time-particularly when exposure to high ozone levels continues for several days. This does not mean that they have developed resistance to ozone. In fact, scientists have found that ozone continues to cause lung damage even when the symptoms have disappeared. The best way to protect your health is to find out when

ozone levels are elevated in your area and take simple precautions to minimize exposure even when you don't feel obvious symptoms.

How do scientists know about the health effects of ozone?



EPA has gathered a great deal of information about the health effects of ozone. This information comes from a number of sources, including animal research, studies that compare health statistics and ozone levels within communities, and controlled testing of human volunteers to determine how ozone affects lung function. In these studies, volunteers are exposed to ozone in specially designed chambers where their responses can be carefully measured. Volunteers are prescreened in medical examinations to determine their health status, and they are never exposed to ozone levels that exceed those found in major cities on a very smoggy day.

Though our understanding of ozone's effects has increased substantially in recent years, many important questions still remain to be investigated. For example, does repeated short-term exposure to high levels of ozone cause permanent lung damage? Does repeated exposure during childhood to high levels of ozone cause reduced lung function in adults? Scientists are continuing to study these and other questions to gain a better understanding of ozone's effects.

How can I find out about ozone levels in my area?

EPA and State and local air agencies have developed a number of tools to provide people with information on local ozone levels, their potential health effects, and suggested activities for reducing ozone exposure.

Air Quality Index. EPA has developed the Air Quality Index, or AQI, (formerly known as the Pollutant Standards Index) for reporting the levels of ozone and other common air pollutants. The index makes it easier for the public to understand the health significance of air pollution levels. Air quality is measured by a nationwide monitoring system that records concentrations of ozone and several other air pollutants at more than a thousand locations across the country. EPA "translates" the pollutant concentrations to the standard AQI index, which ranges from 0 to 500. The higher the AQI value for a pollutant, the greater the danger. An AQI value of 100 usually corresponds to the national ambient air quality standard (NAAQS) for the pollutant. These standards are established by EPA under the Clean Air Act to protect public health and the environment.

The AQI scale has been divided into distinct categories, each corresponding to a different level of health concern. In the table below, the AQI ranges are shown in the middle column and the associated air quality descriptors are shown in the right column. The left column shows the ozone concentrations, measured in parts per million (ppm), that correspond to each category.

Ozone Concentration (ppm) (8-hour average, unless noted)	Air Quality Index Values	Air Quality Descriptor
0.0 to 0.064	0 to 50	Good
0.065 to 0.084	51 to 100	Moderate
0.085 to 0.104	101 to 150	Unhealthy for Sensitive Groups
0.105 to 0.124	151 to 200	Unhealthy
0.125 (8-hr.) to 0.404 (1-hr.)	201 to 300	Very Unhealthy

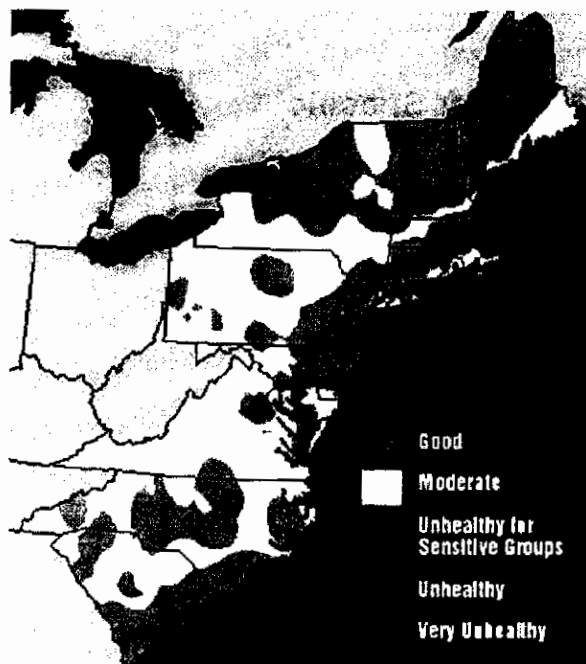
Though the AQI scale extends to 500, levels above 300 rarely occur in the United States. This publication and most other references to the AQI do not list health effects and cautionary statements for levels above 300. If ozone levels above 300 should ever occur, everyone should avoid physical exertion outdoors.

When pollutant levels are high, states are required to report the AQI in large metropolitan areas (populations over 350,000) of the United States. You may see the AQI for ozone reported in your newspaper, or your local television or radio weathercasters may use the AQI to provide information about ozone in your area. Here's the type of report you might hear:

The Air Quality Index today was 160. Air quality was unhealthy due to ozone. Hot, sunny weather and stagnant air caused ozone in Center City to rise to unhealthy levels.

AQI Colors. To make it easier for the public to quickly understand the air quality in their communities, EPA has assigned a specific color to each AQI category. You will see these colors when the AQI is reported in a color format-such as in a color-print newspaper, on television broadcasts, or on your State or local air pollution agency's web site. This color scheme can help you quickly determine whether air pollutants are reaching unhealthy levels in your area. For example, the color orange means that conditions are "unhealthy for sensitive groups," the color red means that conditions are "unhealthy" for everyone, and so on.

Ozone Maps. In many areas of the country, measurements of ozone concentrations are converted into color contours of the AQI categories (green, yellow, orange, red, and purple, shown above) and displayed on a map (see example below) to show ozone levels in the local area. The map is updated throughout the day and shows how ozone builds during hot summer days. In some areas, ozone maps are used to show a forecast of ozone levels for the next day. Once you understand the color scheme, you can use the maps to quickly determine whether ozone concentrations are reaching unhealthy levels in your area. Ozone maps appear on some televised weather broadcasts and are also available from EPA's web site at <http://www.epa.gov/airnow>.



This map shows ozone levels in the eastern United States on August 24, 1998. Ozone maps are updated several times daily to show how ozone levels change throughout the day.

What can I do to avoid unhealthy exposure to ozone?

You can take a number of steps. The chart below, "Health Effects and Protective Actions for Specific Ozone Ranges," tells you what types of health effects may occur at specific ozone concentrations and what you can do to avoid them. If you are a parent, keep in mind that your children are likely to be at higher risk, particularly if they are active outdoors. You may therefore want to pay special attention to the guidance for sensitive groups.

In general, when ozone levels are elevated, your chances of being affected by ozone increase the longer you are active outdoors and the more strenuous the activity you engage in. Scientific studies show that:

- At ozone levels above 0.12 ppm, heavy outdoor exertion for short periods of time (1 to 3 hours) can increase your risk of experiencing respiratory symptoms and reduced lung function.
- At ozone levels between 0.08 and 0.12 ppm, even moderate outdoor exertion for longer periods of time (4 to 8 hours) can increase your risk of experiencing ozone-related effects.

EPA recommends limiting outdoor activities as ozone levels rise to unhealthy levels. You can limit the amount of time you are active outdoors or your activity level. For example, if you're involved in an activity that requires heavy exertion, such as running or heavy manual labor (see "What does exertion have to do with ozone-related health effects?"), you can reduce the time you spend on this activity or substitute another activity that requires less exertion (e.g., go for a walk rather than a jog). In addition, you

can plan outdoor activities when ozone levels are lower, usually in the early morning or evening.

Health Effects and Protective Actions for Specific Ozone Ranges

Ozone Level	Health Effects and Protective Actions
Good	What are the possible health effects? No health effects are expected.
Moderate	What are the possible health effects? - Unusually sensitive individuals may experience respiratory effects from prolonged exposure to ozone during outdoor exertion. What can I do to protect my health? - When ozone levels are in the "moderate" range, consider limiting prolonged outdoor exertion if you are unusually sensitive to ozone.
Unhealthy for Sensitive Groups	What are the possible health effects? - If you are a member of a sensitive group,⁽¹⁾ you may experience respiratory symptoms (such as coughing or pain when taking a deep breath) and reduced lung function, which can cause some breathing discomfort. What can I do to protect my health? - If you are a member of a sensitive group,⁽¹⁾ limit prolonged outdoor exertion. In general, you can protect your health by reducing how long or how strenuously you exert yourself outdoors and by planning outdoor activities when ozone levels are lower (usually in the early morning or evening). - You can check with your State air agency to find out about current or predicted ozone levels in your location. This information on ozone levels is available on the Internet at http://www.epa.gov/airnow.
Unhealthy	What are the possible health effects? - If you are a member of a sensitive group,⁽¹⁾ you have a higher chance of experiencing respiratory symptoms (such as aggravated cough or pain when taking a deep breath), and reduced lung function, which can cause some breathing difficulty. - At this level, anyone could experience respiratory

	effects. What can I do to protect my health? • If you are a member of a sensitive group,⁽¹⁾ avoid prolonged outdoor exertion. Everyone else—especially children—should limit prolonged outdoor exertion. • Plan outdoor activities when ozone levels are lower (usually in the early morning or evening). • You can check with your State air agency to find out about current or predicted ozone levels in your location. This information on ozone levels is available on the Internet at http://www.epa.gov/airnow.
Very Unhealthy	What are the possible health effects? • Members of sensitive groups⁽¹⁾ will likely experience increasingly severe respiratory symptoms and impaired breathing. • Many healthy people in the general population engaged in moderate exertion will experience some kind of effect. According to EPA estimates, approximately: - Half will experience moderately reduced lung function. - One-fifth will experience severely reduced lung function. - 10 to 15 percent will experience moderate to severe respiratory symptoms (such as aggravated cough and pain when taking a deep breath). • People with asthma or other respiratory conditions will be more severely affected, leading some to increase medication usage and seek medical attention at an emergency room or clinic. What can I do to protect my health? • If you are a member of a sensitive group,⁽¹⁾ avoid outdoor activity altogether. Everyone else—especially children—should limit outdoor exertion and avoid heavy exertion altogether. • Check with your State air agency to find out about current or predicted ozone levels in your location. This information on ozone levels is available on the Internet at http://www.epa.gov/airnow.

¹ Members of sensitive groups include children who are active outdoors; adults involved in moderate or strenuous outdoor activities; individuals with respiratory disease, such as asthma; and individuals with unusual susceptibility to ozone.

What does exertion have to do with ozone-related

health effects?

Exercise and outdoor activities can play an important role in maintaining good health. Physical exertion helps build up strength in the heart and lungs. But exerting yourself outdoors can actually increase your chances of experiencing health effects when ozone concentrations are at unhealthy levels. Why is this true? Think of it this way: Exertion generally causes you to breathe harder and faster. When this happens, more ozone is taken into your lungs, and ozone reaches tissues that are susceptible to injury. Research has shown that respiratory effects are observed at lower ozone concentrations if either the level or duration of exertion is increased. This is why EPA recommends decreasing the level or duration of exertion to avoid ozone health effects.

Examples of typical daily activities that involve **moderate exertion** include climbing stairs, light jogging, easy cycling, playing tennis or baseball, and stacking firewood. Outdoor occupational activities such as simple construction work, pushing a wheelbarrow with a load, using a sledgehammer, or digging in your garden, would also involve moderate exertion. Activities that involve **heavy exertion** include vigorous running or cycling, playing basketball or soccer, chopping wood, and heavy manual labor. Because fitness levels vary widely among individuals, what is moderate exertion for one person may be heavy exertion for another. No matter how fit you are, cutting back on the level or duration of exertion when ozone levels are high will help protect you from ozone's harmful effects.



Motor vehicles are a major contributor to smog.

What can I do to reduce ozone levels?

Ground-level ozone is created when certain pollutants, known as "ozone precursors," react in heat and sunlight to form ozone. Cars and

other vehicles are the largest source of ozone precursors. Other important sources include industrial facilities, power plants, gasoline-powered mowers, and evaporation of cleaners, paints, and other chemicals.

We can all help reduce ozone levels by taking the following steps:

- Drive less. For example, instead of using a car, you may want to walk, use mass transit, or ride a bike.
- Carpool.

- Make sure your car is well-tuned.
- Take care not to spill gasoline when you fill the tank of your car or lawn or recreation equipment.
- Make sure that you tightly seal the lids of chemical products-such as solvents, garden chemicals, or household cleaners-to keep evaporation to a minimum.

For more ideas about what you can do, visit EPA's web site at <http://www.epa.gov/airnow/consumer.html>.



You can help reduce ozone levels by walking, biking, carpooling, or using public transportation as an alternative.

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