

# SPORTS MEDICINE

## Handbook



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# Air Quality and Exercise

By Michael C. Koester, M.D., ATC

- Athletes are at special risk of inhaling air pollutants during exercise for a variety of reasons, including increased minute ventilation and diminished nasal filtration.
- The two key air pollutants that may exacerbate asthma or affect the lungs during exercise are ozone and particle pollution.
- Smoke from late summer forest and grass fires is of special concern in the western U.S., often causing severe air pollution coinciding with the beginning of the fall sports season.

## SIGNIFICANCE

While air pollution has been decreasing in the U.S. in most urban centers in recent years, air quality is still a significant concern in athletics. Athletes are at special risk of inhaling air pollutants for the following reasons:

- Increase in respirations during exercise result in the intake of 10 to 20 times the normal volume of air per minute.
- A larger fraction of air is inhaled through the mouth during exercise, bypassing nasal filtration.
- Increased velocity of respirations forces air deeper into the lungs.

**Table 12. General health effects and cautionary statements for exercise in pollution.**

Index Value	AQI	General Health Effects	Cautionary Statements
Up to 50	Good	None for the general population.	None required.
50 to 100	Moderate	Few or none for the general population.	None required.
100 to 200	Unhealthful	Mild aggravation of symptoms among susceptible people, with irritation symptoms in the healthy population.  Activities over 2 hours should decrease in intensity and duration. Add rest breaks or substitutions to lower breathing rates.	Persons with existing heart or respiratory ailments should reduce physical exertion and outdoor activity. General population should reduce vigorous outdoor activity.
200 to 300	Very Unhealthful	Significant aggravation of symptoms and decreased exercise tolerance in persons with heart or lung disease; widespread symptoms in the healthy population.  Sustained rigorous exercise for more than one hour must be rescheduled, moved indoors or discontinued.  Events and contests should be rescheduled or relocated.	Elderly and persons with existing heart or lung disease should stay indoors and reduce physical activity. General population should avoid vigorous outdoor activity.
Over 300	Hazardous	Early onset of certain diseases in addition to significant aggravation of symptoms and decreased exercise tolerance in healthy persons. At AQI levels above 400, premature death of ill and elderly persons may result. Healthy people experience adverse symptoms that affect normal activity.	Elderly and persons with existing diseases should stay indoors and avoid physical exertion. At AQI levels above 400, general population should avoid outdoor activity. All people should remain indoors, keeping windows and doors closed, and minimize physical exertion.

Table adapted from [http://www.scorecard.org/env-releases/def/cap\\_psi.html](http://www.scorecard.org/env-releases/def/cap_psi.html)

## BACKGROUND

Air pollution has long been known to worsen the symptoms of asthma and other respiratory diseases. In athletes without asthma, the effects of air pollution upon athletic performance and the long-term consequences of exercising in air pollution are not well understood. There is some evidence to indicate that chronic exposure may adversely affect blood vessels throughout the body, but more studies need to be done.

There are two key sources of air pollution that may exacerbate asthma or potentially affect the lungs in other ways: *ozone* and *particle pollution*. Ozone is found in smog and is often at its worst on hot summer days, in the late afternoon and early evening. It forms through a variety of complex chemical interactions, all of which require sunlight as a catalyst. Ozone can travel significant distances and, contrary to conventional wisdom, is more predominantly a rural pollutant.

Particle pollution can be bad at any time of the year, especially when the air is still. Particle pollutants can be high near busy roads and factories, and at times when there is smoke in the air from wood stoves, fireplaces or wildfires. Smoke from late summer forest and grass fires is of special concern in the western U.S., often causing severe air pollution coinciding with the beginning of the fall sports season. Other potentially harmful air pollutants include carbon monoxide, nitrogen oxides and sulfur dioxide.

Air pollution may also occur indoors. Potential sources include tobacco smoke in any situation, dust in indoor rodeo arenas and exhaust fumes from ice resurfacing equipment in ice arenas. Athletes with asthma should always have their medication available and be especially cautious in these venues (See Asthma chapter).

## RECOGNITION AND MANAGEMENT

The Air Quality Index (AQI) is a system developed by U.S. Environmental Protection Agency to help the public determine if air quality levels in a specific location are good, moderate, unhealthful or worse. The AQI describes the general health effects associated with different pollution levels, as well as whatever precautionary steps may need to be taken if air pollution levels rise into the unhealthful range (Table 12). During times of suspected high air pollution, the AQI should be checked prior to all practices and contests. A particular location's AQI can be found at: <http://www.airnow.gov/>.

The AQI measures five separate air pollutants (particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide and ozone), and converts the measured pollutant concentrations in a community's air to a number on a scale of 0 to 500. The intervals on the AQI scale relate to the potential health effects of the daily concentrations of each pollutant. The most important number on this scale is 100, as this number corresponds to the National Ambient Air Quality Standard established under the Clean Air Act. An AQI level greater than 100 indicates that a pollutant is in the unhealthful range whereas an AQI level at or less than 100 indicates that a pollutant is in the satisfactory range.

Here are some suggested guidelines for managing potential air quality problems:

- Distance runners should avoid running next to busy roadways.
- Ozone exposure can be lessened by early morning workouts.
- Athletes with asthma must be carefully monitored when the AQI is above 100 and a rescue inhaler should be readily available (see Asthma chapter). Asthma symptoms may not worsen until the following day after exposure to air pollution.
- Practices and contests should be modified or moved indoors when the AQI is above 100 and consideration given to rescheduling or moving them when the AQI is greater than 200.

## References

Carlisle AJ, Sharp NCC. Exercise and outdoor ambient air pollution. *British Journal of Sports Medicine* 2001; 35:214-22.

[www.scorecard.org/env-releases/def/cap\\_psi.html](http://www.scorecard.org/env-releases/def/cap_psi.html)

[www.airnow.gov/](http://www.airnow.gov/)

[www.airnow.gov/index.cfm?action=topics.smoke\\_events](http://www.airnow.gov/index.cfm?action=topics.smoke_events)