Particulate matter (PM)
PM is a heterogeneous mixture of small solid or liquid particles that can be inhaled. Fine particles (PM$_{2.5}$) are generated by combustion processes, including diesel-powered engines, power generation, and wood burning. Larger particles (PM$_{10}$) come from dust produced by construction, mining, and agricultural activities. Particles can also include dirt, soot, smoke, and even liquid droplets (aerosols) emitted from factory smokestacks and other sources. In California, wildfires cause high levels of particulates in affected areas.

Health impacts: when particulate matter is inhaled, it causes lung damage and breathing problems and can trigger asthma.

Nitrogen dioxide (NO$_2$)
NO$_2$ is a brownish acidic gas that reacts with other gases to form ozone. Fuel emissions from cars, trucks, and power plants are sources of NO$_2$.

Health impacts: NO$_2$ irritates the lungs, causing bronchitis and pneumonia.

Sulfur dioxide (SO$_2$)
Point sources such as power plants produce SO$_2$ or acid sulfate particles. SO$_2$ is formed by burning sulfur-containing fuels such as coal and oil. Steel mills and paper mills also create SO$_2$ pollution.

Health impacts: exposure causes breathing problems and lung damage, especially for those with asthma, bronchitis, and emphysema.

What Role Does Air Pollution Play in Worsening Childhood Asthma?
Children are more likely than adults to be affected by outdoor air pollutants since they spend more time outdoors and have higher respiration rates. They also tend to breathe more through their mouths than through their noses, so fewer particles are filtered out as air enters their lungs.

Scientific studies conducted in California and throughout the U.S., as well as in other countries, have found strong relation-
ships between four outdoor air pollutants—NO₂, PM, O₃, and SO₂—and the following asthma-related outcomes in young children and adolescents:3,6-8

- Reduced lung function and increased inflammation. Outdoor pollutants such as O₃,9 PM₂.₅, 10-12 PM₁₀,12 NO₂,10,11,13 and SO₂ are known to exacerbate asthma by causing inflammation in the airways and decreasing lung function.
- Increase in symptoms like wheezing and coughing. Several outdoor pollutants have been shown to increase asthma symptoms in children (O₃,9,14-16 PM₂.₅,17 PM₁₀,9,12,16,17 NO₂,9,10,13,15,16,18,19 and SO₂3,13,15).
- Increased hospitalization and Emergency Department (ED) visits. Outdoor air pollutants such as O₃,20-24 PM₂.₅,25 PM₁₀,26-28 NO₂,29,31 and SO₂ can also trigger severe asthma attacks, resulting in ED visits and hospitalization.
- Increased medication use for asthma, such as quick-relief inhalers. Exposure to O₃,14,32 PM₂.₅,33 PM₁₀,33-35 NO₂,18,19 and SO₂ can exacerbate asthma and increase inhaler use among children.
- Missed school days. O₃,37 PM₂.₅,10 PM₁₀,38 NO₂,16 and SO₂ are related to school absences in children with asthma.

Is Outdoor Air Pollution a Cause of Asthma?

In addition to exacerbating asthma, outdoor air pollution has now been implicated in the development of new asthma cases. The Children’s Health Study, a long-term study of more than 3,000 children in 12 southern California communities, found that traffic-related pollutants contribute to the onset of asthma. In addition the study found that children playing three or more team sports in high ozone areas have an increased risk for developing asthma.

What Can Be Done About Outdoor Air Pollution?

Community Action to Fight Asthma (CAFA) is a network of asthma coalitions in California working to shape local, regional, and state policies to reduce the environmental triggers of asthma for school-aged children where they live, learn, and play. A few examples of local and state policies related to outdoor air pollution are listed below:

- Promote siting of schools, playgrounds, athletic fields, and subsidized housing away from major outdoor air-pollutant sources such as high-traffic roads and freeways.
- Institutionalize and enforce diesel emissions—reduction policies and procedures.
- Reduce pollution at the ports, on truck routes, and in communities across the state.
- Replace the worst polluting school buses to reduce children’s exposure to diesel exhaust.

Please visit our website at www.rampasthma.org to learn more about Community Action to Fight Asthma, connect with local coalitions, locate asthma resources across California, and sign up for our e-newsletter.

References


7 Graham, L. M. “All I need is the air that I breath: outdoor air quality and asthma.” Paediatric Respiratory Reviews 5 (Supplement A): S59–64 (2004).


