



Mount Sinai Pediatric Environmental Health Specialty Unit WTC Particulate Matter Fact Sheet

This fact sheet answers frequently asked health questions (FAQs) about particulate matter (PM_{2.5} and PM₁₀). It is part of a series of fact sheets describing potential health risks to children from exposures related to the World Trade Center.

What is particulate matter?

A major indicator of overall air quality is the amount of particulate matter in the air. Particulate matter is the term used for microscopic airborne particles. Dust, soot, smoke and cigarette fumes, in addition to byproducts of gas combustion such as sulfur dioxide and nitrogen dioxide, are all components of particulate matter. Together, these components are more generally known as outdoor air pollutants.

Major sources of particulate matter include emissions from motor vehicles and factories. Formation of particulate matter can also occur as a result of fires, work on construction or demolition sites, and through natural erosion.

The level of exposure to particulate matter depends on proximity of the child's home and school to major sources including factories, major roadways, and diesel bus stations. In general, cities tend to have higher levels of particulate matter than suburban areas.

Levels can also fluctuate with the time of day and overall weather patterns. During rush hour, traffic and congestion on the roads leads to increased vehicle emissions. High winds promote the spread of particulate matter. Also, outdoor particulate matter is more likely to reflect the degree of indoor air pollution in warmer seasons when there is increased ventilations of homes and schools due to open windows and doors.



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How are children exposed to particulate matter?

Children are exposed to particulate matter through inhalation of pollutants in the air. Children are particularly sensitive to air pollutants for several reasons. First of all, children breathe more rapidly than adults, allowing for the inhalation of more pollutants per pound of body weight. Children also spend more time playing outdoors close to the ground, increasing the likelihood of being exposed to outdoor air pollutants.

In addition, both fine and coarse particles are associated with health risks in children. The diverse sources of particulate matter result in a wide range of particle sizes, from fine particles of 2.5 micron in diameter (PM_{2.5}) to particles of 10 micron in diameter (PM₁₀) and greater. Fine particles less than 2.5 microns can only be seen with the aid of a microscope. For comparison, the width of a hair is 75 microns. Children tend to breathe by their mouths, bypassing the body's natural defense mechanisms, which prevent particles larger than 10 microns from passing through the nose. Normally, only particles 5 microns and smaller can clear the nasal passages and get inhaled into the lungs.

What were the sources of particulate matter at the World Trade Center?

The collapse of the World Trade Center led to the release of particulate matter from the breakdown of the building's structures and contents. This resulted in tons of dust, rubble and debris at the site of Ground Zero. In addition, the release of gases, dust, soot and smoke formed as a result of the fires at the site were clearly evidenced by the smoke plumes seen in varying degrees for the duration of the fires through December 2001.



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Is my child at risk of exposure to particulate matter related to the collapse of the World Trade Center?

With the passage of the Clean Air Act in 1970, federal standards imposed limits on exposures to major air pollutants, including particulate matter. National Ambient Air Quality Standards (NAAQS) were set to protect the health of the most vulnerable populations, namely children, elderly and people with chronic illnesses such as heart or lung disease.

The current standards for particulate matter are:

PM2.5

15 micrograms/meter cubed averaged over a year
65 micrograms/meter cubed averaged over a 24-hour period

PM10

50 micrograms/meter cubed averaged over a year
150 micrograms/meter cubed averaged over a 24-hour period

While these standards provide a general reference for outdoor air quality, they are not useful to the general public as a means to gauge their activities in real time. Subsequently, a PM2.5 Air Quality Index (AQI) level of concern of 40 micrograms/meter cubed was set to give the general public a reference by which to judge their day-to-day levels of concern.

Routine monitoring of particulate matter conducted by the Environmental Protection Agency provides us with historical levels of these pollutants in New York City. Data prior to September 11, 2001 indicate outdoor particulate matter levels of 18.4 micrograms/meter cubed for PM2.5 (year 2000 average) and levels of 25 micrograms per meter cubed for PM10 (1998 average). Twenty-four hour levels for New York City have been reported as high as 40-89 micrograms per meter cubed for PM2.5 and 51-121



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micrograms per meter cubed for PM10 (1996-2001). This indicates that even pre-9/11 levels of particulate matter exceeded the National Ambient Air Quality Standards, most likely reflecting background levels of air pollution in urban areas.

NYC Background Levels of Particulate Matter

Annual Average PM2.5: 18.4 ug/m³ (2000)
24 Hour Average PM2.5: 40-89 ug/m³ (1996-2001)

Annual Average PM10: 25.0 ug/m³ (1998)
24 Hour Average PM10: 51-121 ug/m³ (1996-2001)

In the immediate aftermath of the collapse of the World Trade Center, there were large increases in hourly levels of PM2.5 at and above the AQI level of 40 micrograms per meter cubed. In general, these short-term elevations of particulate matter levels followed the path of the smoke plumes, depending on wind direction. Levels of particulate matter were higher at nighttime and lower on rainy days since moisture decreased the amounts of airborne dust, soot and debris. Though some hourly levels were reported as high as 200 micrograms per meter cubed, 24 hour averages for these same areas were significantly lower at 40 to 90 micrograms per meter cubed. While these 24-hour values are elevated, they are similar to background levels of air pollution seen previously in New York City.

Overall, levels quickly decreased to what is considered normal background levels for New York City by mid-October. This emphasizes the fact that periods of high exposure to particulate matter were of a short duration. Comprehensive sampling conducted by the Environmental Protection Agency at the World Trade Center site for PM2.5 averaged 13.47 micrograms per meter cubed for September 2001 through May 2002. PM10 levels for the same period averaged 32.75 micrograms per meter cubed. These 9-month averages are well below the NAAQS for particulate matter.



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Independent sampling for indoor respirable particulates (PM_{2.5}) was conducted by the New York City Board of Education to evaluate the levels of exposure in lower Manhattan Public Schools. The majority of sampling conducted at P.S. 89, P.S. 150, P.S. 234, Stuyvesant High School, High School for Economics and Finance and High School for Leadership and Government met the NAAQS. There were few elevated 24-hour levels for particulates greater than the AQI standard of 40 micrograms per meter cubed and few samples obtained greater than 65 micrograms per meter cubed. However, these readings were rare and most likely representative of urban background levels of particulates found in New York City pre-9/11.

Research conducted by New York University found elevated levels of particulate matter larger than 10 microns. Prior to September 11, particulates larger than 10 microns were not routinely monitored since they are too large to clear the nasal passages and so were not thought to be associated with health risks. These larger particles, alkaline in nature, are thought to be responsible for what is widely known as the World Trade Center cough problematic in firemen, volunteers, workers and residents that represent the most highly exposed populations.

How does particulate matter affect the health of children?

Acutely, exposure to particulate matter may irritate the eyes, ears, nose, throat and lungs. Respiratory symptoms such as coughing, wheezing and shortness of breath may be seen as well. The symptoms vary from person to person and depend on the particular components of the pollutants. Usually the symptoms resolve once the exposure is removed.

Long-term health effects are unlikely to result from short-term exposures. Children with chronic illnesses however may experience increased symptoms from exposure. For example, children with asthma may experience an asthma exacerbation when exposed to



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high levels of particulate matter. Studies have shown increased rates of asthma hospitalizations in association with elevated levels of air pollution and proximity to major roadways. Children with heart disease may also experience chest pain and shortness of breath when exposed to particulate matter.

Exposure to air pollution during pregnancy has been linked to premature birth, low birth weight, Sudden Infant Death Syndrome (SIDS) and heart defects. These exposures included carbon monoxide and ozone in addition to particulate matter.

Is my child at risk of health effects from possible particulate matter exposure after the collapse?

While high levels of particulate matter were present immediately after the World Trade Center collapse, levels steadily decreased by mid-October to what was considered normal background levels for New York City. This emphasizes that the duration of exposure was brief. Long-term health effects are unlikely to result from short-term exposures to particulate matter.

Health effects in children caused by particulate matter exposure can include acute asthma exacerbations and eye, ear, nose and throat irritation. These symptoms are reversible and occur acutely. Elevated levels post 9/11 are consistent with historical levels of particulates in New York City and are thought to be responsible for the increasing rates of asthma in major cities.

Ongoing studies are assessing the effects of short-term exposures in pregnant women present in lower Manhattan at the time of the collapse to determine the health effects in babies exposed in the womb.



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How do we test for exposure to particulate matter?

There is no test recommended to assess the degree of exposure to particulate matter.

How do we treat children exposed to particulate matter?

There is no known treatment to reduce the levels of particulate matter already inhaled into the body. Most importantly, your family should minimize further exposures to particulate matter. Local TV news and newspapers provide health alerts for high pollutant days. Decreasing your child's time outside on these days and keeping your home's windows and doors shut will help minimize your child's exposures.

Treatment is tailored to the symptoms present in your child. If your child exhibits signs of wheezing or shortness of breath, he/she should be seen by a pediatrician to determine if allergy or asthma medications are needed.

How do we prevent further exposure?

The mainstay of treatment is to minimize any further exposure to particulate matter. The Environmental Protection Agency (EPA) has made the following recommendations:

- Outdoor air pollutant alerts are provided on the local TV news and in newspapers. If outdoor levels are high, keep windows and doors closed to prevent further circulation of particles into the home.
- Limit time outdoors on high alert days for sensitive populations such as children and elderly.



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- Have your ventilation system filters inspected and changed regularly.
- If outdoor air quality is good, open your doors and windows to increase ventilation in the home.
- Reduce indoor sources of particles such as propane and wood burning stoves and furnaces, natural gas stoves and ovens, and gas logs.
- Avoid smoking or burning candles in the home, both of which greatly increase the particle levels in the home.
- When vacuuming areas with large amounts of dust, consider using a hepa-vacuum, which prevents particles from being re-circulated into the air.
- Wipe floors and hard surfaces with a damp mop or cloth that will retain the dust, rather than re-circulate it into the air.



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Where can I get more information?

For more information, contact the Mount Sinai Pediatric Environmental Health Specialty Unit, Mount Sinai Medical Center, 1 Gustave L. Levy Place, Box 1512, New York, NY 10029. Phone: 1-866-265-6201 or 212-241-0938. Fax: 212-241-4309. Visit us online at.

You may also contact your local health or environmental department or regional EPA office. Or, visit the U.S. Department of Health and Human Service's Agency for Toxic Substances and Disease Registry (ATSDR) ToxFAQs for particulate matter.

