

Air Pollution and Children's Health: The Medical Evidence

Marc McDermott MD, EdM

University of Utah Health Sciences Center

Public Air Quality Advisory:
"Unhealthy for Sensitive."

Air Pollution and Children's Health: the Medical Evidence

- Does air pollution cause asthma in children?
- Does air pollution make children with asthma have more:
 - Hospitalizations or Emergency Department visits?
 - Use of medications? Asthma symptoms?
 - Missed days of school?
- Which pollutants are responsible?
- Can public health measures decrease the morbidity?
 - Does cleaning the air reduce the health effects?
 - Do people follow the EPA guidelines for avoiding air pollution?
 - Do the guidelines work to prevent disease?

The Answers! (Without intricacies, controversy or elaboration)

- Does air pollution cause asthma in children? *Maybe*
- Does air pollution make children with asthma have more:
 - Hospitalizations or Emergency Department visits? *YES*
 - Use of medications? Asthma symptoms? *YES*
 - Missed days of school? *YES*
- Which pollutants are responsible? *Ozone and Particulates*
- Can public health measures decrease the morbidity?
 - Does cleaning the air reduce the morbidity? *YES*
 - Do people follow...guidelines for avoiding air pollution? *MAYBE*
 - Do the guidelines work to prevent disease? *UNKNOWN*

Children are not little adults!



Children's Behavior and Physiology are Different

- Children spend more time outdoors
- When outside, they exercise more
- At play or at rest, they breathe more air per pound than adults
- Children tend to breathe through their mouth
- Children may continue playing even when asthma attacks occur
- Children are still young: anything that affects their health can last a lifetime.

Does Air Pollution Cause Emergency Department Visits in Kids With Asthma?

- Fauroux, et al. *Ozone: A Trigger for Hospital Pediatric Asthma ER Visits.*, Pediatric Pulmonology, 2000
- Considered 1,020 pediatric ED visits for asthma in Paris.
- Controlled for temperature, pollen, influenza, other factors.
- Found that the risk of pediatric asthma attacks was 1.5x greater on days following a high ozone day.

Do ozone and particulates cause kids with asthma to have more symptoms or need more medicine?

- Gent et al. *Association of Low-Level Ozone and Fine Particles with Respiratory Symptoms in Children with Asthma.*, JAMA 2003
- Studied 271 children younger than 12 with asthma
- Daily log of symptoms and medication use kept by parents from April-Sept 2001
- Compared symptoms to ozone and particulate matter data from the area. Controlled for other variables
- EPA standards were never exceeded for PM, exceeded only 3 times for 1-hour ozone and 10 times for 8 hour ozone.

Study Results

Positive Findings

- Children with asthma severe enough to require controller medicines had more symptoms and rescue medicine use on higher ozone days.

Negative Findings

- Particulate matter not associated with symptoms (but PM levels were low).
- Children with mild asthma not affected by this low level of pollution.

Does PM Exposure Trigger Decreased Lung Function in Asthmatic Children?

- Delfino, et. al. Association of FEV1 in Asthmatic Children with Personal Microenvironmental Exposure to Airborne Particulate Matter. Environmental Health Perspectives, 2004
- Asthmatic children's lung function decreased when exposure to PM increased.
 - This study used sophisticated equipment to frequently measure lung function, personal, indoor, outdoor and central site exposure.
 - Results suggested that children with both asthma and allergies were more susceptible to PM.

Does PM Exposure Lead to More Use of Asthma Medicines?

- Gordian, et.al. *PM10 and Asthma Medication in Schoolchildren*. Archives of Environmental Health, 2003
- School nurses in Anchorage, Alaska, provided more asthma medicine to their students during periods of sustained high PM.
 - Study controlled for some other environmental factors (temperature, day of the week, time of year.)

Does Air Pollution Cause Kids to Miss School?

- Gilliland et al. *The effects of ambient air pollution on school absenteeism due to respiratory illness*. Epidemiology 2001
- Found that a 20 ppb increase in ozone was associated with a 83% increase in school absence for respiratory illness.
- Chen et al. *Elementary School Absenteeism and air pollution*, Inhalation Toxicology, 2000.
- Found a 50 ppb increase in the mean 14 day ozone value lead to a 13% increase in school absence.

Does Air Pollution Cause Children to Develop Asthma?

- McConnell et al *Asthma in exercising children exposed to ozone: a cohort study*., Lancet 2002
- Followed 3535 initially healthy children for 5 years.
- Recruited children from six “high pollution” communities and six “low pollution” communities
- 265 children reported a new diagnosis of asthma during the study.

Study Results

- Risk of developing asthma was NOT greater in children living in the “high pollution” communities.
- Children who both played 3 team sports *and* lived in high pollution communities had a 3.3x risk of developing asthma

Does Air Pollution Lead to Deficient Lung Development?

- Gauderman WJ et al. *The Effect of Air Pollution on lung Development from 10 to 18 years of Age*. NEMJ September, 2004.
- Children living in high pollution communities were more likely to have poor growth on lung function tests than those living in low pollution areas.
- 8 year prospective study! 1759 subjects! More kids developed an asthma type pattern on their lung function tests if they lived in polluted areas.
- Ozone NOT associated with these findings, other pollutants WERE!

Ways to Reduce Exposure



- Reduce the ambient air pollution!
- Stay inside
- Reduce “minute ventilation” by not exercising

Can A City Reduce Pediatric Asthma by Reducing Ozone?

- Friedman et al. *Impact of changes in transportation and commuting behaviors during the 1996 Summer Olympic Games in Atlanta on air quality and childhood asthma.* JAMA 2001
- During the Olympics, Atlantans were forced to utilize more public transportation
- Weekday AM traffic counts reduced 22%
- Ozone levels reduced 28% (81 ppb -> 59 ppb peak value)
- Asthma attacks down 42% amongst childhood Medicaid population.

Do Citizens Follow EPA Air Quality Alerts? (Utah Data)

- McDermott, Srivastva, Croskell; *Parents Awareness of and Compliance With Air Pollution Advisories*; paper to be submitted for publication, 2004.
- 88% of parents are aware that Utah issues alerts when air quality is poor.
- 55% of parents say they follow the alerts “some or most” of the time they are issued
- Parents of kids with asthma report significantly more awareness of and compliance with the alerts.
- Most (75%) parents report changing their behavior 5 times/year or less (there are an average of 31 alerts/year in the study area.)

Do Citizens Follow EPA Air Quality Alerts? (National Data)

- Mansfield C, Corey C. Task 4: Analysis of Survey Data on Ozone Alert Days. Final Report. Research Triangle Park (NC): Environmental Protection Agency (US). 2003, Sept. EPA Contract Number 68-D-99-024. Research Triangle Institute project number 7647.004.399.
- A national survey found that 37% of people living in a county with ozone alerts were aware of them. Of those people, 57% reported decreasing outdoor activity and 56% reported decreasing driving on day's alerts were issued.
- IMPLICATION: On an ozone alert day, as many as 20% of the population might follow the guidelines. This is probably a maximal estimate.

Can Children Avoid Pollution by Staying Inside?

- Ozone is very reactive and breaks down inside. Indoor levels rise, but not very much, when outdoor levels are high. Lee et al. *Nitrous acid, nitrogen dioxide and ozone concentrations in residential environments*. Environ Health Perspectives, 2002
- Particulates penetrate indoors and do not degrade. Indoor PM increases along with outdoor PM, reaching perhaps 70% of outdoor levels. Sarnat et al. *Cofounder or surrogate: the role of gaseous pollutants in particulate matter epidemiology*. Environ Health Perspectives 2001
- Monn et.al. *Particulate Matter less than 10 microns (PM10) and fine particles less than 2.5 microns (PM2.5): relationships between indoor, outdoor and personal concentrations*. Sci Total Environ, 1997.
- For a detailed discussion, see Liu, et al, *Exposure Assessment of Particulate Matter for Susceptible populations in Seattle*. Environmental Health Perspectives, 2003.

Can We Prevent Disease by Limiting Outdoor Exertion?

- This has not been directly studied.
- Actions taken to reduce exposure by remaining indoors are more likely to work for ozone (summer haze) than for particulate matter (winter smog).
- Exercise has well documented benefits for children. We should not restrict it without good reason.

Summary of the Literature

- This is an area with hundreds of studies.
- Studies vary in methodology and specific findings.
- The main findings are consistent: Ozone and particulate matter exacerbate asthma in children and may cause lung disease to develop in healthy kids.

Implications for Public Health

- Children with asthma are vulnerable to air pollution. They deserve special protection from it.
- Children with other conditions (*cystic fibrosis, congenital heart disease, etc.*) are likely to suffer from air pollution as well and should also be protected.

Three Priorities: First --

- Study Whether Following the EPA Air Quality Advisories Prevents Disease
 - The Hawthorne elementary school project here in Salt Lake City is planning to do just that.
 - Contact Libbey Mathews at Utah Dept. of Health for details. (Lmathews@utah.gov)

Three Priorities: Second --

- Until that is done, parents and organizations should follow the EPA Guidelines because they are very reasonable.

Three Priorities: Most Important!

- **Clean the Air**

- We know it works!
- Will allow children freedom to play and free schools and parents from having to track the air quality.
- Potentially, it would save time and money now spent monitoring the air.