

Health Update

Ozone and PM2.5 Cause Symptoms in Children with Asthma

April 22, 2004



Good Morning

In today's health update I will describe and interpret the results of a study performed to evaluate the impacts of ozone and PM2.5 on asthmatic children.

You have heard on numerous occasions that people with existing respiratory illness, including those with asthma, are at special risk of experiencing adverse health outcomes if exposed to ozone and particulate matter in ambient air. Further, children and especially children with asthma have been shown to suffer when air pollution levels rise. They need medical help, must limit their activities, and take medication to ease their symptoms.

“Association of Low-Level Ozone and Fine Particles With Respiratory Symptoms in Children With Asthma”

Janneane Gent, et al., JAMA, 290, pages 1859-1867 (2003)

- Objective
 - To examine effects of ozone and PM_{2.5} at levels below EPA standards and symptoms and medication use in children with asthma

The study to be discussed today follows up on general observations regarding children with asthma and their response to common air pollutants, ozone and fine particulate matter (PM_{2.5}).

The title of this paper is “Association of Low-Level Ozone and Fine Particles With Symptoms in Children with Asthma”

The investigators are from Yale and Rochester Universities.

The specific objective of this study was to examine whether exposure to pollutants at levels below federal standards impact asthmatic children and whether they suffer symptoms and take more medication to relieve these symptoms as ozone and PM_{2.5} increase.

Study Details

- 270 young asthmatic children recruited in New England--80% Caucasian
- Half took at least occasional “maintenance” medication, half took none
- Symptoms and “rescue” medication use evaluated April through September 2001
- Ozone and PM 2.5 levels during study were low
 - Federal 1-hour ozone standard (120 ppb) violated 3 times
 - Federal 8-hour ozone standard (80 ppb) violated 10 times
 - Federal 24-hour PM2.5 standard (65 µg/m³) was not violated

In this prospective epidemiological study the investigators recruited children, aged 12 and younger, from communities in Connecticut and Massachusetts.

The children were split into two groups --those who routinely took maintenance medication to maintain control over their asthma and those without routine maintenance medication: Both groups took rescue medications, often called inhalers, whenever they experienced asthma symptoms. It was assumed that those children who required routine maintenance medication were more severely asthmatic than those who did not take maintenance medications.

Health outcomes were recorded by parents and included a series of respiratory symptoms commonly experienced by asthmatics and the frequency of rescue medication use.

The concentrations of ozone and PM_{2.5} were low during the study period --the spring and summer of 2001-- with few violations of federal ozone standards and none of the PM_{2.5} standard.

Study Findings

- **General health observations**

- Kids using “maintenance” medication had more severe asthma

- They had more respiratory symptoms (chest tightness, shortness of breath, cough and/or wheeze)

- They used more “rescue” medication for relief

As anticipated, children taking maintenance medication were found to have more severe asthma.

They had more symptoms, such as chest tightness, shortness of breath, cough, and wheeze than did children who did not take routine maintenance medication.

The more severely asthmatic children also took more medication to respond to their symptoms.

Study Findings (cont.)

Responses in “severe” asthmatics

- **When same day ozone levels were above**
 - 51 ppb (1-hr)---more wheeze, bronchodilator use
 - 63 ppb (8-hr)---more chest tightness
- **When prior day ozone levels were above**
 - 52 ppb (1-hr)---more chest tightness
 - 59 ppb (1-hr)---more shortness of breath
 - 72 ppb (1-hr)---more persistent coughs
 - 52 ppb (8-hr)---more chest tightness, cough, shortness of breath

Specific health findings from this study are complex, but are summarized on this and following slides.

Those children with more severe asthma, as defined by their at least occasional maintenance medicine usage, showed more wheeze and rescue medication use on days when one-hour ozone levels exceeded 51 ppb. They experienced more chest tightness when one-hour ozone levels exceeded 63 ppb.

When the investigators considered the association between the prior day’s exposure and symptoms they found that several of the symptoms were associated with both one-hour or 8-hour average ozone levels.

In the cases of wheeze with same day 1-hour ozone and chest tightness with prior day 1-hour ozone a dose response relationship is seen. Each step increases in pollutant level was reflected by an increased degree of health outcome. Such observations enhance the credibility of study findings.

Please note that these ozone concentrations are considerably below either federal or California state (90 ppb for 1 hour) standards.

Study Findings (cont.)

- Same day PM2.5 levels
 - Few effects found
- When prior day PM2.5 levels were
 - 19 $\mu\text{g}/\text{m}^3$ or higher---more cough, chest tightness, shortness of breath

Responses in less “severe” asthmatics

- Ozone
 - Almost no effects detected
- PM2.5
 - Almost no effects detected

Particulate matter did not produce as large an array of associations with symptoms. Only prior day concentrations above 19 $\mu\text{g}/\text{m}^3$ produced more cough, chest tightness, or shortness of breath.

There were almost no observations of either symptoms or rescue drug use related to ozone or PM2.5 exposures found in children who were classified as less severely asthmatic.

The authors caution that levels of PM2.5 were much lower than expected during this study period and that further studies are needed to further characterize how asthma in children is influenced by this pollutant.

Implications and Applications

- Adds to existing knowledge about ozone
- Suggests that ozone increases medication use
- Meds don't make asthmatic kids immune to ozone
- Will be considered in ozone standards review
- Do not view PM2.5 as harmless to asthmatic kids

This study adds important new information to what we already know about ozone's health impacts on children and especially for those with asthma. It tells us that kids with asthma may be especially responsive to low levels of ozone.

It tells us that when ozone levels go up so does the use of rescue medication. These rescue medications are powerful drugs, quite capable of causing harm with heavy or prolonged use.

This study did not attempt to determine whether maintenance drugs reduce the harmful effects of ozone. It is clear, however that routine use of maintenance drugs does not completely prevent all symptoms of asthma or the need for medicine to relieve kids of these symptoms. And while the researchers refer to children in this study as "more severely asthmatic" it is clear that they represent a large number of children with asthma.

Medication regimes for asthma are complex and research on ozone and drug use is suggested by this work.

This study is a first report of ozone-medication findings in children. The results will be considered in our review of the ozone standard. It suggests that neither federal nor California State standards for ozone appear to fully protect kids with asthma from the symptoms seen.

Finally, while most findings were made for ozone, not PM2.5, the authors point out that the levels of PM were very low and slightly higher values could still be harmful.