

Health Update:

Effects of Ozone and Allergen Exposure on Allergic Asthmatics

April 24, 2003



California Air Resources Board

California Environmental Protection Agency

Good morning, Dr. Lloyd and members of the Board. The study we are discussing today deals with ozone health effects in people with asthma.

The health effects of air pollution on people with asthma have been a concern of the Board for some time due to the sensitivity of this vulnerable population. Results of many epidemiological studies have demonstrated statistical associations between ambient ozone exposures and emergency room visits and hospital admissions for asthma.

To give you a perspective on the magnitude of this issue, over 300,000 California residents visited the emergency room during 2001 because of their asthma.

However, a biological explanation for why asthmatics may be vulnerable to air pollution's effects is only just beginning to emerge.

Ozone Exposure Increases Eosinophilic Airway Response Induced by Previous Allergen Challenge

B. Vagaggini et al., University of Pisa, Italy

American Journal of Respiratory and Critical Care
Medicine. 166: 1073-1077,2002.

This morning we would like to tell you about a recently published paper entitled “Ozone exposure increases eosinophilic airway response induced by previous allergen challenge”, by Vagaggini and colleagues from the University of Pisa in Italy. The paper appeared in late 2002 in the American Journal of Respiratory and Critical Care Medicine.

Background

- ◆ Link between asthma exacerbation and ozone exposure in epidemiology studies
 - Ozone alone does not exacerbate asthma
- ◆ Characteristics of asthma:
 - Chronic eosinophilic airway inflammation
 - Reversible bronchoconstriction
 - Airway hyperreactivity
 - Allergy is a prominent feature

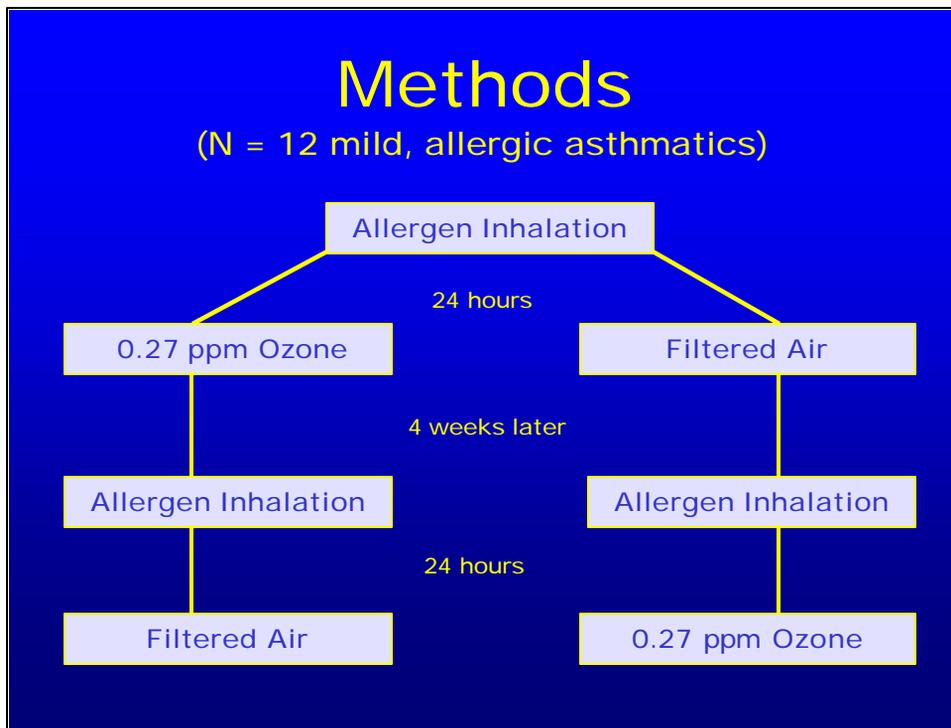
Purpose: Investigate the effect of ozone exposure on subjects experiencing allergen-induced asthma exacerbation

As I mentioned, epidemiological studies have reported an association between ozone exposure and emergency room visits and hospital admissions for asthma. However, in most studies of asthmatics who have been exposed to controlled concentrations of just ozone, the asthmatics have shown responses that were not different from nonasthmatics. This raises the question of how to reconcile these disparate findings.

Asthma is a chronic lung disease characterized by airway inflammation that is primarily related to a type of immune cell called the eosinophil. Eosinophils release chemicals that induce inflammation of the lung tissues. These cells are also involved in allergic responses inside the lungs. Other features of asthma include reversible airway constriction, and hyperreactive airway muscle cells. Allergy is a prominent feature in most cases of asthma.

Ozone is not an allergen, however some researchers have hypothesized that ozone may increase ongoing allergic responses by increasing the intensity of airway inflammation, and thereby increasing bronchoconstriction and airway hyperreactivity in asthmatics.

The purpose of this study was to investigate the effects of ozone exposure in allergic asthmatics who were already experiencing allergen-induced asthma exacerbation.



The study involved 12 mild, allergic asthmatics who attended the laboratory on four days. In order to induce an asthma exacerbation, subjects were asked to inhale allergens on the first day. 24 hours later the subjects were exposed to either filtered air or 0.27 ppm ozone for two hours, and performed 20 minutes of light exercise during each hour. At least four weeks later the subjects repeated the allergen inhalation, and 24 hours later completed a 2 hour exposure to the opposite atmosphere as previously, that is, ozone or filtered air. All subjects completed both exposures.

The ozone concentration used, 0.27 ppm, is higher than has been measured in California in recent years. It was chosen to maximize the possibility of elucidating the biological mechanisms involved in the responses of interest, while ensuring subject safety and the relevance of the results to current ambient conditions. Further, the study involved mild asthmatics. It is likely that more severe asthmatics would experience similar responses with lower levels of ozone exposure.

The measures of respiratory health included lung function tests, and the presence and severity of a list of respiratory symptoms, including among others, cough, chest tightness, pain on deep breath and nose and throat irritation. The number of eosinophils in sputum samples was used as an index of the degree of allergic inflammation in the lungs.

Results

- ◆ Filtered air exposure:
 - No change in pulmonary function
 - No change in respiratory symptoms

- ◆ Ozone exposure:
 - Reduced pulmonary function
 - Increased respiratory symptoms
 - Increased allergic inflammation compared to filtered air exposure

Two hours of exposure to filtered air did not change lung function or respiratory symptoms in these subjects.

In contrast, a two hour exposure to ozone resulted in reduced lung function, and increased respiratory symptoms, such as cough, chest tightness and pain on deep breath, compared to the filtered air exposure.

In addition, exposure to ozone increased the number of eosinophils in the lungs, compared to exposure to filtered air. This means that ozone inhalation increased the allergic inflammation that had been induced by the allergen exposure on the previous day.

Conclusions

- ◆ Ozone exposure can increase allergen-induced airway inflammatory responses in subjects with allergic asthma
- ◆ Provides a biological basis for the association between ozone and asthma exacerbation reported in epidemiology studies
- ◆ Controlled studies may underestimate the effect of ozone on asthmatics

These results indicate that ozone exposure can intensify allergic inflammatory responses induced by previous allergen exposure in subjects with mild allergic asthma.

Further, the results provide a biological explanation for the increased emergency room visits and hospital admissions for asthma exacerbation observed in epidemiological studies.

Finally, this report illustrates that other exposure studies that do not include an allergen challenge may underestimate the impact of ozone on the health of asthmatics.

Thank you. We would be happy to respond to questions at this time.