

The Effect of Ozone on Asthma in Sensitive Individuals



September 25, 2003



Air Resources Board
California Environmental Protection Agency

(Slide 1) Introduction

Thank you Ms. Witherspoon. Good morning Chairman Lloyd and members of the Board. For today's health update I will be discussing two recent toxicology studies on ozone and allergic responses. These studies may provide information on possible mechanisms behind ozone's respiratory effect and help explain the results from previous studies on the effects of ozone on sensitive individuals with asthma.

Background

⊙ Children's Health Study

- O₃ is associated w/ reduced lung function
- O₃ + several sports → children are more likely to develop asthma

⊙ Epidemiology Studies

- increased response of asthmatics to O₃

⊙ Chamber Study

- allergen + O₃ = increased effects



(Slide 2) Background

The health effects of air pollution on asthmatics have been a concern of the Board for some time due to the fact that asthma currently is one of the most common chronic and disabling diseases among children and adults.

Previously the Children's Health Study found that children that live in high ozone communities have reduced lung function, and those who play several sports in these high ozone communities are more likely to develop asthma than children who play no sports.

In addition, epidemiology studies have found that increased medication use and increased asthma symptoms were associated with ozone exposure in asthmatics.

These studies provided a significant association between ozone and asthma among sensitive individuals. However, they do not provide us with a biological explanation for why Children and asthmatics may be more vulnerable to ozone's effects. The following studies attempt to do this.

In April of this year, we presented to the board a controlled chamber study. The results showed that asthmatic individuals challenged with an allergen showed increased asthmatic effects when exposed to ozone, demonstrating a synergistic effect between ozone and allergen.

The next two recently published studies that I will be introducing to the board today provide further biological evidence of this synergistic effect between allergens and ozone.

Ozone-Induced Modulation of Airway Hyper-Responsiveness in Guinea Pigs

- ⊙ **O₃ without allergen**
 - no hyper-responsiveness
- ⊙ **O₃ + Allergen ⇒ Synergistic Effect**
 - O₃ exacerbated hyper-responsiveness
 - Persisted for 4 weeks after O₃ exposure ceased

“Ozone-Induced Modulation of Airway Hyperresponsiveness in Guinea Pigs”,
Schlesinger et al., Health Effects Institute Report 109, 2002



(Slide 3) “Ozone-Induced Modulation of Airway Hyper-responsiveness in Guinea Pigs

This study in Guinea Pigs, was designed to examine the effect of ozone on airway hyper-responsiveness, which is an increased tendency of the bronchial airways to constrict and one of the hallmarks of asthma in humans.

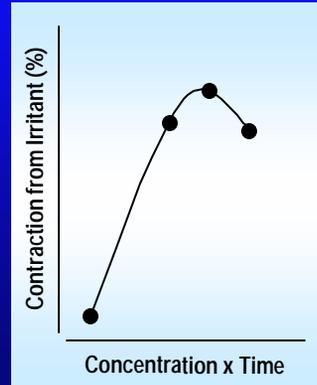
This study used an animal model to explain the effects of ozone exposure in non-allergic and allergic animals. Using this model, this study sought to determine whether longer-term, intermittent exposure to ozone induces or worsen airway hyper-responsiveness in animals who are sensitive to allergens and irritants.

The results of this experiment demonstrate that animals exposed to ozone alone did not develop airway hyper-responsiveness. However, animals sensitive to allergens showed increased airway hyper-responsiveness when exposed to ozone and then challenged to the allergen or irritant. Therefore, ozone exacerbated the constriction of the bronchial airways synergistically with the allergen. This increased tendency of the bronchial airways to constrict persisted for up to 4 weeks after ozone exposure ceased.

In Vitro Effect of Air Pollutants on Human Bronchi

Human bronchial muscle

- ⊙ Tissue w/ allergen + O₃
 - a synergistic effect
 - potentiates the contractile response
- ⊙ Synergistic effect depends on
 - concentration of pollutant
 - duration of pollutant exposure



"In Vitro Effect of Air Pollutants on Human Bronchi",
Roux et al.,
University of Bordeaux, France 2002



(Slide 4) In Vitro effect of air pollutants on human bronchi an other recent toxicologic finding

The second study examined the responsiveness of the mechanisms of bronchi muscle contraction after exposing the isolated bronchial tissue to ozone. The experimental results indicate that exposure to ozone potentiates the contractile response in human bronchi when challenged to a specific allergen.

This synergistic effect of allergen and ozone depends on both the concentration and duration of exposure to the pollutant.

This graph shows the effect of ozone on bronchi responsiveness to an irritant challenge. The higher the concentration and duration of the exposure the higher the contraction due to the irritant challenge. At very high doses there is a toxic effect with a downward trend.

These two toxicologic findings combined, help provide a possible biological explanation for why and how sensitive individuals are more susceptible to the effect of ozone.

Implications/Future Research

- ◎ **Toxicological Studies Indicate**
 - **O₃ - allergen effects are synergistic**
 - **O₃ effects depend on duration and level of exposure**
- ◎ **Information for O₃ standards**
- ◎ **FACES Health Study Underway**
 - **help clarify role of O₃ and allergens in asthmatics**



(Slide 5) IMPLICATIONS/FUTURE RESEARCH

We have seen from these two toxicological studies that ozone and allergen appears to have a synergistic effect in the lungs. Its effects depend on the duration and concentration of ozone exposure.

These results contribute to our knowledge of how ozone works to worsen the medical symptoms related to asthma. These studies indicate that some asthmatics may be particularly vulnerable to the harmful effects of ozone.

In addition, this will help provide general information to the Board during the ozone standard review process.

Finally, further study on long term ozone exposure and its effects on vulnerable asthmatic populations is underway. The Fresno Asthmatic Children's Environment Study (FACES) funded by ARB is designed to help clarify the role of ozone and allergens such as pollens, molds, and endotoxins in the exacerbation of asthma.

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(Slide 6) Conclusion

Thank you for your attention today, I would be happy to answer any questions.