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Disclosures

- **FEDERAL FUNDING**
  - US Environmental Protection Agency
  - National Institute of Environmental Health Sciences
  - National Center for Advancing Translational Sciences
  - National Institute of Allergy and Infectious Diseases

- **CORPORATE /ORGANIZATIONAL**
  - Associate Editor, JACI
  - Board of Directors, AAAAI
  - Springer (Editor, Current Allergy and Asthma Reports)
  - Up-to-Date
  - Glaxo Smith Kilne (Clinical Trial)
Climate Change and Ambient Air Pollution

Outdoor pollution
General facts about pollutant exposure and asthma exacerbation

• Generally, increases in asthma exacerbation occurs 24-48 hours after the pollutant exacerbation
• Often, exacerbations occur with pollutant exposures less than current NAAQS standards
• Pollutants enhance response to allergen
Actions of Inhaled Pollutants

• Ozone
  » Acute airway inflammation
  » Increased airway reactivity
  » Temporarily immediate decrease in lung function
  » Increased airway reactivity (twitchiness)

• PM
  » Acute airway inflammation
  » Some increased airway reactivity (twitchiness)
  » May decrease lung function
  » CV effects
    • Coagulation
    • HRV
Asthmatics are more susceptible to ozone effects and have increased response to allergens after ozone exposure.

(Kehrl et al, 1999)
### Air Quality Index for Ozone

<table>
<thead>
<tr>
<th>Index Values (Conc. Range)</th>
<th>Air Quality Descriptors</th>
<th>Cautionary Statements for Ozone</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 50 (0-60 ppb)</td>
<td>Good</td>
<td>No health impacts are expected when air quality is in this range.</td>
</tr>
<tr>
<td>51 – 100 (61-75 ppb)</td>
<td>Moderate</td>
<td>Unusually sensitive people should consider limiting prolonged outdoor exertion.</td>
</tr>
<tr>
<td>101 – 150 (76-104 ppb)</td>
<td>Unhealthy for Sensitive Groups</td>
<td>Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.</td>
</tr>
<tr>
<td>151 – 200 (105-115 ppb)</td>
<td>Unhealthy</td>
<td>Active children and adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion; everyone else, especially children should limit prolonged outdoor exertion.</td>
</tr>
<tr>
<td>201 – 300 (116-374 ppb)</td>
<td>Very Unhealthy</td>
<td>Active children and adults, and people with respiratory disease, such as asthma, should avoid all outdoor exertion; everyone else, especially children, should limit outdoor exertion.</td>
</tr>
</tbody>
</table>
# AQI-PM

## Air Quality Guide for Particle Pollution

<table>
<thead>
<tr>
<th>Adjective</th>
<th>Air Quality Index (AQI)</th>
<th>Concentration PM 2.5 ((\mu g/m^3) 1-3 hr. avg.)</th>
<th>Cautionary Statement</th>
<th>Health Effects Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>0-50</td>
<td>0-38</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Moderate</td>
<td>51-100</td>
<td>39-88</td>
<td>Unusually sensitive people should consider reducing prolonged or heavy exertion.</td>
<td>None</td>
</tr>
<tr>
<td>Unhealthy for Sensitive Groups</td>
<td>101-150</td>
<td>89-138</td>
<td>People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.</td>
<td>Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly.</td>
</tr>
<tr>
<td>Unhealthy</td>
<td>151-200</td>
<td>139-351</td>
<td>People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.</td>
<td>Increased aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; increased respiratory effects in general population.</td>
</tr>
<tr>
<td>Very Unhealthy Alert</td>
<td>201-300</td>
<td>352-526</td>
<td>People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.</td>
<td>Significant aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; significant increase in respiratory effects in general population.</td>
</tr>
<tr>
<td>Hazardous</td>
<td>300+</td>
<td>526+</td>
<td>People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.</td>
<td>Significant aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; significant increase in respiratory effects in general population.</td>
</tr>
</tbody>
</table>
Figure 8. Ozone concentrations in ppm, 2010 (fourth highest daily maximum 8-hour concentration).
PM-2.5 Nonattainment Areas (2006 Standard)

Nonattainment areas are indicated by color. When only a portion of a county is shown in color, it indicates that only that part of the county is within a nonattainment area boundary.
Anticipated increases in ozone levels in 2030 due to increased greenhouse gas emissions

Similar increases in particulate matter as well
Wildfires and woodsmoke

An emerging threat
Aerial Photos of exposed areas of NC with 2008 Eastern NC wildfires
Asthma ED visits and risk of adverse health outcomes with the wildfires
Climate Change: Impact on Allergens and Viruses

Increased CO2 linked to increased Ragweed Pollen and increased Amb a 1 concentration/mg pollen
Change in the length (days) of ragweed pollen season as a function of frost-free days with latitude for the period 1995–2009.

Ziska L et al. PNAS 2011;108:4248-4251
Fig. 2. RSV incidence in Florida compared to temperature and rainfall (June 2010 to May 2013).

Stuart Paynter, Peter D. Sly, Robert S. Ware, Gail Williams, Philip Weinstein

The importance of the local environment in the transmission of respiratory syncytial virus ★ ★ ★

http://dx.doi.org/10.1016/j.scitotenv.2014.06.021
Potential Interventions

Personal and Societal
Fluticasone Propionate Protects against Ozone-Induced Airway Inflammation and Modified Immune Cell Activation Markers in Healthy Volunteers

Neil E. Alexis,¹,² John C. Lay,¹ Angela Haczku,³ Henry Gong,⁴,⁵ William Linn,⁴,⁵ Milan J. Hazucha,¹ Brad Harris,¹ Ruth Tal-Singer,⁶ and David B. Peden¹,²

**Figure 2.** The percent sputum neutrophils after $O_3$ exposure for each pretreatment dose of FP (0.5 or 2 mg) or placebo.

* $p < 0.05$ compared with placebo.
Mean Levels of Major Pollutants Before, During, and After the 1996 Summer Olympic Games as a Percentage of the National Ambient Air Quality Standard (NAAQS)

Table 1. Acute Asthma Events and Acute Nonasthma Events Among Children and Youth During the 1996 Summer Olympic Games Compared With the 1996 Summertime Baseline Period

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Type of Asthma Event</th>
<th>Mean (SD) No. of Events Per Day</th>
<th>% Change</th>
<th>Mean (SD) No. of Events Per Day</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Baseline Period®</td>
<td>Olympic Period†</td>
<td></td>
<td>Baseline Period®</td>
</tr>
<tr>
<td>Georgia Medicaid claims file</td>
<td>Emergency care and hospitalizations</td>
<td>4.23 (2.81)</td>
<td>2.47 (1.46)</td>
<td>−41.6</td>
<td>100.5 (18.6)</td>
</tr>
<tr>
<td>Health maintenance organization</td>
<td>Emergency care, urgent care, and hospitalizations</td>
<td>1.36 (1.63)</td>
<td>0.76 (0.83)</td>
<td>−44.1</td>
<td>37.6 (19.6)</td>
</tr>
<tr>
<td>Pediatric emergency departments</td>
<td>Emergency care and hospitalizations</td>
<td>4.77 (2.52)</td>
<td>4.24 (2.49)</td>
<td>−11.1</td>
<td>118.4 (20.5)</td>
</tr>
<tr>
<td>Georgia Hospital Discharge Database</td>
<td>Hospitalizations</td>
<td>2.04 (1.53)</td>
<td>1.65 (1.50)</td>
<td>−19.1</td>
<td>19.7 (5.1)</td>
</tr>
</tbody>
</table>

*Defined as June 21–July 18 and August 5–September 1, 1996.
†Defined as July 19–August 4, 1996.
Ensemble-mean U.S.-average population-weighted annual 8-h-max O3 and PM2.5 in 2000, 2050, and 2100 under REF, POL4.5, and POL3.7 scenarios.
Summary

- Asthma is characterized by increased response to a number of agents
  - Air pollutants
  - Allergens
  - Viruses

- Climate Change will increase:
  - Air pollutants
  - Allergens
  - Viral seasons

- It is still possible for:
  - People to protect themselves from asthma attacks due to pollution and other agents
  - Decrease the impact of climate change with environmental policy