Does Particulate Matter Cause or Exacerbate Asthma?  
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**Impact and Outcomes**

- **Background**
  - Air pollution is a significant cause for exacerbation of asthma, and may contribute to development of disease as well. Particulate matter has been associated with exacerbation of asthma and wheezing in children, and is a leading cause of exacerbations. Air pollution is likely second only to viral respiratory tract infections as a precipitating factor in acute events, rescue medication use, ER visits and hospitalizations.

  - While earlier epidemiological studies demonstrate that PM contributes to exacerbation of asthma, the degree to which PM influences disease, and the potential for PM to contribute to pathogenesis of chronic diseases remain incompletely understood. It is also unclear if PM of specific size ranges, or if specific components of PM are more likely to induce asthma. PM is composed of bioaerosol components (e.g. endotoxin and lipoteichoic acid), metals, organic molecules such as polyaromatic hydrocarbons and elemental carbon. Biological responses to these individual components agents likely play a central role in determining individual susceptibility to asthma.

  - Previous studies also indicate that a significant action of PM is to enhance atopic immune response to allergens, and diverse agents such as PAHs on diesel exhaust and endotoxin have been shown to enhance primary and recall response to allergen. Mechanisms by which this occurs are also incompletely understood.

  - Understanding these mechanisms may provide insight into targets for individual intervention approaches and regulatory strategies to minimize the impact of PM on asthma.

- **Science Questions**
  - A number of scientific hypotheses have been addressed in the research outlined in this poster. These hypotheses address the following questions:
    - Does PM contribute to exacerbation of asthma?
    - Does PM contribute to development of asthma?
    - How does PM influence immune function in the airway to promote asthma?
    - Are patients with asthma at increased risk to the cardiac health effects of PM?

- **PM-induced enhanced antigen-presentation may promote asthma**
  - Epidemiological and animal studies demonstrate that PM can exacerbate asthma and increase atopy and airway hyperreactivity.

  - Population studies show that PM, traffic and other air pollutants can increase the risk of developing asthma.

  - Animal, human, and in vitro studies demonstrate that PM and components augment antigen presentation which would enhance reactivity with allergen and promote asthma.

- **PM exposure can cause cardiovascular effects in asthmatics**
  - Human time-series and controlled exposure studies show that asthma may be increased risk to the cardiac effects of PM.

**Findings and Conclusions**

- **Eggs can cause asthma**
  - Population studies show that PM, traffic and other air pollutants can increase the risk of developing asthma.

  - Animal, human, and in vitro studies demonstrate that PM and components augment antigen presentation which would enhance reactivity with allergen and promote asthma.

- **Future Directions**
  - **Studies to determine how PM enhances response to allergen.** Focus on effects of the following:
    - Antigen specific IgE
    - Antigen presenting cells (cells which bear IgE (basophils, mast cells)
  - **Genetic Risks associated with pollutant exposures.**
    - Examination of gene expression profiles to identify candidate mechanisms which mediate response to PM in asthmatics.
    - Examination of effect of oxidant stress genes thought to play a role in asthma.
  - **Examine novel interventions.**
    - Pursue studies examining the role of antioxidants such as sulforaphane. vitamin C and vitamin E in minm.
    - Effect of co-exposure on asthma outcomes.
    - Determine if PM augments the effect of other pollutants such as ozone.

**Methods/Approach**

- **Change in Pediatric Lung Function per 10 µg/m³ change in PM in Seattle, WA.**
  - Odds ratios for daily asthma symptoms associated with shifts in within-subject concentrations of two pollutants.

- **Change in HRV per 1 µg/m³ increase in PM in adults with asthma.**
  - Hazard ratio of newly diagnosed asthma in 12 communities by average ambient pollutants.

- **Prevalence of asthma by distance to major road.**
  - Hazard ratio of newly diagnosed asthma in 12 communities by distance to major road.

**Impact and Outcomes**

- **What are the public health and environmental outcomes of this research?**
  - Evidence that diesel, fine and coarse mode PM identify targets for regulation and community mitigation strategies to protect asthmatics from PM-associated health effects.
  - Potential community mitigation strategies include:
    - Better emission controls on mobile sources for PM.
    - Continue to examine state implementation plans for point source pollutants of PM that affect asthma.
    - Consider placement of schools and residential buildings in proximity to roadways.
    - Individual intervention strategies include:
      - Use of anti-inflammatory medications to decrease effect of PM on antigen presenting cells and responses allergen.
      - Influence family decisions regarding living in proximity to roadways.
      - Have asthma treatment plans that minimize co-exposures to allergens and indoor pollutants.

**Health and Exposure**