Healthcare in a Changing Climate: Understanding the Impacts on Virginians

Health Practitioners’ Perspectives

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Who is at more Risk?

LG: 8 yo AAM – Moderate Asthma
- 31 weeks birth
- Intermittent wheeze with illness
- ICS/LABA
  - FVC = 1.58 L (97%)
  - FEV1 = 1.22 L (84%)
- BMI = 28
- No outdoor play due to neighborhood

CP: 17yo WM - EIB
- Term birth, maternal smoking
- Allergic rhinitis: tree, grass, mold
- SABA prn, LTM seasonally
  - FVC = 4.45 L (83%)
  - FEV1 = 4.06 L (88%)
- BMI = 19
- Cross country team
“Near” Risks

**Indoor air quality**
- Homes and Schools
- Smoking, mold, other allergen, CO

**Outdoor air quality**
- Organic sources: pollens, organic industrial by products
- Pollution sources: local traffic, energy production, manufacturing,
- Local thermal inversion
“Far” Risks

• Regional and Global air pollution
• Greenhouse gases influences
• Extremes of heat and cold
• Floods and natural disasters
• Aeroallergens
Exercise Induced Bronchoconstriction and Environment

- Abnormal airway constriction in response to vigorous exercise
- Airway mediators released in response to triggers
- Triggers
  - Temperature
  - Humidity
  - Chemical irritants
  - Particulate matter

EIB increases
- PM exposure
- Ozone exposure
- Low Humidity
- NO2 (asthmatics)
  - Glutathione depletion
  - Nitric oxide interactions

Air Pollen and Pollution Worsen Asthma Control

• *in vitro* studies show increased inflammation in sensitized cells
• Controlled pollutant exposures show negative pulmonary function
• Effect of Climate change/pollution is complicated
• Increased PM 2.5 and increased Pollen severity demonstrated poorer asthma control (Li *et al*.) - PM2.5, O3, Pollen density

• Limitations
  • Patient population
  • Indoor pollutants not included
  • Other outdoor pollutants
  - Proximity to monitoring sites - ZIP
  - Types of pollens/sensitization

Mortality and Particulate Air Pollution

Multi-City Multi-Country Collaborative Research Network (MCC)

- 652 Urban areas in 24 countries/regions
- Environmental and health data - 1986-2015
- PM$_{10}$ – 598 cities
- PM$_{2.5}$ – 499 cities
- Both – 445 cities in 16 countries
- Temperature, humidity, gaseous pollutants (ozone, NO$_2$, SO$_2$, CO)
- Estimate increase in mortality with increase PM

Mortality and Particulate Air Pollution

• Estimated *all-cause, cardiovascular, and respiratory mortality* affected by increase of \( \text{PM}_{2.5} \) and \( \text{PM}_{10} \) (2-day moving average)

• Estimated change in mortality remained significant after adjustment for \( \text{NO}_2 \) and \( \text{SO}_2 \) (less for ozone, \( \text{CO} \))

• Association of *all-cause mortality* stronger in locations with lower annual mean PM and higher annual mean Temperature

• Concentration-response curves flattened at high range concentration AND detectable at levels below most standards

Mortality and Particulate Air Pollution

Figure 3

Asthma: Genetic susceptibility and Environmental pollutants

Figure 1. gene-air pollution interaction effects in asthma.

Figure 2. suggested biological mechanism for gene-air pollution interactions involving allele-specific DNA methylation of genetic loci

Johansson et al. Current Opinion in Immunology 2019, 60: 156-162
What Can Be Done?

- 4 year lung function in 3 cohorts
  - ‘94–‘97, ‘97-2000, ‘07–‘10
- With and without asthma
- Southern California
- Reduction in pollutants improved lung growth
- Increased proportion with normal Lung function

Gaudermann et al. N Engl J Med 372;10