Looking for Associations between Air Quality and Health

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Overview

- EPA grant
- Sources of health and air quality data
- Issues of assigning exposure value
- Two methods of analysis we are using
- Preliminary results
- Odds ratio and attributable fraction
- Other areas for analysis
U.S. EPA STAR Grant (R833627010)

- Local initiatives and national policies expected to reduce emissions of air pollutants
  - Unique opportunity to measure impacts on population exposure and association with health outcomes
EPA STAR Grant

✔ Develop and evaluate outcome-based environmental health indicators
  – 8 year study period (2002-2009)
  – Statistical models used to track health effects associated with changes in air quality
Two Study Populations

- Twin Cities Seven County Metro
- Olmsted County
Health Outcome Data

🌟 **Hospitalizations**
- Asthma
- Chronic Lower Respiratory Disease
- Total Respiratory Disease
- Cardiovascular Disease

🌟 **Mortality**
- Cardiopulmonary Disease
- All Causes
Air Quality Data

- **PM$_{2.5}$**
  - Monitored data
    - 1 in 3 and 1 in 6 days
    - 24 hour continuous (hourly)
  - Modeled data
    - Emissions model
    - Hierarchical Bayesian model

- **Ozone**

- **Speciated PM$_{2.5}$**
  - Sulfates, nitrates, carbon
Air Quality data choice issues

- Need to assign population exposure

- 4 sources of PM$_{2.5}$
  - 1 in 3 and 1 in 6 days
  - 24 hour continuous (hourly)
  - Emissions model
  - Hierarchical Bayesian model
Monitor Locations- 7 County Metro

- Continuous Monitors
- Ozone Monitors
- 1:3 and 1:6 Monitors
Closest Monitor to Zip Code Centroid
Monitor Spatial Variation
Emissions model data

4 km grid

Zip code level

PM2.5 Concentration (ug/m3)
Hierarchical Bayesian modeled data

- Combines monitored and modeled data
- More weight is given to data where monitors are located
- Very complex statistical modeling
- Requires significant computer resources
What measure do we use?

- PM is a regional pollutant
- For initial analyses, use one average value for the 7 county area
- Previous studies used one value for entire city exposure
- May represent individual patterns of exposure
Statistical Methods for Analysis

- Time Series-Poisson model
- Case-Crossover analysis
Time Series Analysis

- Daily counts of adverse events modeled against daily air quality values over time
- Need to control for time trends, seasonality and correlated data
- Covariates
  - Temperature, humidity, holidays, flu epidemics, day of the week
- No individual level data are used
Total Respiratory Time Series results
Total Respiratory Time Series results

![Graph showing odds ratio with lag days on the x-axis and odds ratio on the y-axis.](image)
Case-Crossover Analysis

 Modification of Case Control analysis

 Cases serve as their own control

 - Controls for individual factors
  - Smoking status, age, race, gender, occupation, other health conditions
Case-Crossover Analysis

- Relies on choice of referent time and lag structure
- Model is less complex than time series
- Individual level data is used
  - Can be used as effect modifiers
  - Gender, Age group
Case-Crossover Analysis

- Open source software program available through CDC EPHT program
  - Case-crossover analysis tool (C-CAT)
Referent time and lag structure

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Referent times

Lag times
Choice of Lag Day Structure

★ Possible lag structures
  – Individual days
    • lag0, lag1, lag2…
  – Average lags
    • Average of lag0, lag1 and lag2
  – Cumulative lags
    • Sum of lag0, lag1 and lag2

★ Driven by clinical evidence

★ Chosen by modeling strategy
Case-Crossover results

Odds ratio vs. Lag days

- Lag 0: 1.01 (95% CI: 0.98 - 1.04)
- Lag 1: 1.02 (95% CI: 1.00 - 1.04)
- Lag 2: 1.03 (95% CI: 1.01 - 1.05)
Population Attributable Fraction

- Proportion of the disease in a population that would be eliminated if the exposure to the risk factor were eliminated
- Assuming the exposure causes the outcome
- Needs an estimate of pollutant level that would exist if there were no man-made emissions in the US
Attributable Fraction results
Directions for future analyses

- Spatially assigned air data
- Other pollutants ($\text{PM}_{10}$, ozone)
- Traffic data
- Ambulance data
- Pediatric vs. Adult
- Seasonal data (ozone)
- Pollen
- Noise
Directions for future analyses

- Rochester Epidemiology Project
  - Asthma data
  - Clinic visit clusters
  - Prescription data for exacerbation
  - Geocoded data for better exposure assignment

- Speciated PM$_{2.5}$ monitor
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