Variation of Residential Levels of Nitrogen Dioxide in a Mixed Rural-Urban Setting and its Implication in Childhood Asthma

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Background

- What is known? 
  - Observational study at a national level using US Census data and model-based traffic-related air pollutants (TRAP) data to estimate residential exposure levels of nitrogen dioxide (NO2) and its association with asthma incidence and outcome (eg, symptoms)
  - Prospective studies examining the association between NO2 and childhood asthma are often conducted in urban communities where traffic volume, level of NO2, and asthma prevalence are relatively higher than in rural or mixed rural-urban areas.
  - High prevalence of asthma in Olmsted County, MN, a mixed rural-urban community has been reported (13% in Olmsted County vs. 8% in US)

- What is unknown? 
  - Little is known of residential level of indoor and outdoor NO2 in Olmsted County, MN, a mixed rural-urban setting, and its implication to childhood asthma outcomes.

Aim

1. To identify variation and risk factors of residential NO2 (indoor and outdoor) in a mixed rural-urban community.
2. To assess the impact of residential levels of indoor and outdoor NO2 during heating season on asthma outcomes among children with asthma.
3. To develop a regression model for NO2 based on local data for use in population-based public health.

Methods

- Study setting, design and subjects: Olmsted County, MN, a mixed rural-urban setting
  - A prospective cohort study collaboration between Mayo Clinic, University of Minnesota, and University of Iowa
  - A random sample of children with persistent asthma derived from children seen at the Mayo Clinic in a primary care clinic and hospitalized.

- Aim: To place to safely place outdoor monitor, no asthma controller medication, other respiratory condition exposure (eg, smoking status, indoor or outdoor), and a median daily NO2 concentration

- Study subject
  - Indoor environment: second hand smoking exposure
  - Prospective studies examining the association between asthma outcomes (frequency of asthma symptoms, medication use, and unscheduled clinic visits) and a median daily NO2 concentration

- Limitations: 
  - What is unknown?
    - Prospective studies examining the association between asthma outcomes and indoor NO2 exposure are rare and necessary for understanding which factors contribute to higher levels of exposure.

- Statistical analysis
  - Descriptive statistics:
    - Linear regression model (unadjusted) was used for examining associations between asthma outcomes and indoor NO2 exposure.

- Tables 1. Basic characteristics of study subjects

Table 2. Association of NO2 with environmental conditions

Table 3. Association of indoor and outdoor NO2 with asthma outcomes (continuous)

Results & Discussion

- Measuring NO2 in a mixed rural-urban community is feasible, inexpensive, and necessary for understanding which factors contribute to higher levels of NO2 exposure.
- This study suggests that it is feasible to develop traffic-volume, land-use regression model for NO2 based on local data for use in population-based public health.
- Measuring NO2 in a mixed rural-urban community is feasible, inexpensive, and necessary for understanding which factors contribute to higher levels of NO2 exposure.

- Conclusions
  - Measures of indoor and outdoor NO2 were lower than Environmental Protection Agency annual standard (80 ppm) in residential areas.
  - We do not find any statistically significant differences between residential indoor and outdoor NO2 levels.
  - NO2 levels in our study are lower than expected from Environmental Protection Agency annual standard (80 ppm). They may be due to lower traffic volumes and lower densities of traffic in our study area.

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