AIR POLLUTION AND ASTHMA NATIONAL STUDY

CARTEEH

Southern Transportation and Air Quality Summit
August 20-21, 2019

Haneen Khreis Ph.D. and Joe Zietsman Ph.D., P.E.

Texas A&M Transportation Institute, Center for Advancing Research in Transportation Emissions, Energy, and Health (CARTEEH)

https://www.carteeh.org/
CARTEEH – Tier 1 Center
Transportation Emissions and Health Spectrum

Full Chain from Air Pollution Sources to Health Impacts
14 Pathways Between Transportation and Health

**BENEFICIAL TO HEALTH**
- Green Spaces and Aesthetics
- Physical Activity
- Access
- Mobility Independence

**DETRIMENTAL TO HEALTH**
- Contamination
- Social Exclusion
- Noise
- Urban Heat Islands
- Vehicle Crashes
- Air Pollution
- Community Severance
- Electromagnetic Fields
- Stress
- Greenhouse Gas Emissions

**PATHWAYS TO HEALTH**
Open access data and paper.

Traffic related air pollution and the burden of childhood asthma in the contiguous United States in 2000 and 2010

Raed Alotaibi\textsuperscript{a,b,c}, Mathew Bechle\textsuperscript{d}, Julian D. Marshall\textsuperscript{d}, Tara Ramani\textsuperscript{a}, Josias Zietsman\textsuperscript{a}, Mark J. Nieuwenhuijsen\textsuperscript{e,f,g}, Haneen Khreis\textsuperscript{a,e,f,g,*}

\textsuperscript{a} Center for Advancing Research in Transportation Emissions, Energy, and Health (CARTEEH), Texas A&M Transportation Institute (TTI), TX, USA
\textsuperscript{b} Department of Family and Community Medicine, Imam Abdulrahman Bin Faisal University, Saudi Arabia
\textsuperscript{c} Texas A&M Health Science Center School of Public Health, TX, USA
\textsuperscript{d} Department of Civil and Environmental Engineering, University of Washington, Seattle, WA, USA
\textsuperscript{e} ISGlobal, Centre for Research in Environmental Epidemiology (CREAL), Barcelona, Spain
\textsuperscript{f} Universitat Pompeu Fabra (UPF), Barcelona, Spain
\textsuperscript{g} CIBER Epidemiología y Salud Pública (CIBERESP), Madrid, Spain

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\textbf{ABSTRACT}

\textit{Background}: Asthma is one of the leading chronic airway diseases among children in the United States (US). Emerging evidence indicates that Traffic Related Air Pollution (TRAP), as opposed to ambient air pollution, leads to the onset of childhood asthma. We estimated the number of incident asthma cases among children attributable...
Asthma is the *reversible* or partially reversible *obstruction of airflow*

**Globally**
330+ million people with asthma

**United States**
20 million *adults* and 6 million *children*

Economic burden of asthma in the U.S. was **$81.9 billion in 2013**
Traffic Related Air Pollution (TRAP)

Estimated using **surrogates**

- Buffer zone (distance to road and traffic)
- Chemical surrogates (NO$_2$, PM, BC, etc.)

**NO$_2$** is a good predictor of traffic
Scope of the Study

- 48 states and D.C.
- 2000 & 2010
- Census Block level
- NO$_2$, PM$_{2.5}$ and PM$_{10}$
- Children under 18
Estimated the Burden of Disease using the following data

1. Concentration Response Functions (*Literature*)
2. Concentration Estimation (Regression *Models*)
3. Asthma Incidence Rate (*Literature*)
4. Population Exposed (*Census Data*)

Using standard burden of disease assessment methods

- **Attributable number** of asthma incident cases
- **Percentage** of asthma incident cases
- Among Children (<18 years)
1. Concentration Response Functions

Review article

Exposure to traffic-related air pollution and risk of development of childhood asthma: A systematic review and meta-analysis

Haneen Khreis a,*, Charlotte Kelly a,b, James Tate a, Roger Parslow c, Karen Lucas a, Mark Nieuwenhuijsen d,e,f

a Institute for Transport Studies, University of Leeds, Leeds, United Kingdom
b Leeds Institute of Health Sciences, University of Leeds, Leeds, United Kingdom
c Leeds Institute of Cardiovascular and Metabolic Medicine, University of Leeds, Leeds, United Kingdom
d ISGlobal CREAL, C/Dr. Aiguader 88, 08003 Barcelona, Spain
e Universitat Pompeu Fabra (UPF), C/Dr. Aiguader 88, 08003, Barcelona, Spain
f CIBER Epidemiología y Salud Pública (CIBERESP), C/Monforte de Lemos 3-5, 28029 Madrid, Spain
1. Concentration Response Functions (continued)
2. Concentration Estimation

- Annual average concentrations (ug/m$^3$)
  - EPA air quality monitor readings
  - Satellite data
  - GIS (impervious surfaces, elevation, major roads, residential roads, and distance to coast)
  - Centroid of each census blocks
  - Highly predictive of spatial variability ($R^2 = 0.82$)

National Spatiotemporal Exposure Surface for NO$_2$: Monthly Scaling of a Satellite-Derived Land-Use Regression, 2000–2010

Matthew J. Bechle,$^\dagger$ Dylan B. Millet,$^{\dagger,\ddagger}$ and Julian D. Marshall$^{\star,\dagger}$

$^\dagger$Department of Civil, Environmental, and Geo- Engineering and $^{\ddagger}$Department of Soil, Water, and Climate, University of Minnesota, Minneapolis, Minnesota 55455, United States
3. Asthma Incidence Rate

- Asthma Call Back Survey
- Period 2006-2008
- 12.5 per 1,000 at-risk children
- Not all states included
4. Population Exposed

**Census data**

National Historical Geographic Information System (NHGIS)

- Population count (including children)
- Urban/Rural areas
- Median household income
5+ million populated census blocks
70+ million children
(80%) live in Urban areas
Results
### Attributable number of cases and percentage of all cases

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2010</th>
<th>2000</th>
<th>2010</th>
<th>AC</th>
<th>% of all cases</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NO₂</strong></td>
<td>209,100</td>
<td>142,000</td>
<td>27%</td>
<td>18%</td>
<td>-32%</td>
<td>-33%</td>
<td></td>
</tr>
<tr>
<td><strong>PM₂.₅</strong></td>
<td>247,100</td>
<td>190,200</td>
<td>31%</td>
<td>24%</td>
<td>-23%</td>
<td>-24%</td>
<td></td>
</tr>
<tr>
<td><strong>PM₁₀</strong></td>
<td>331,200</td>
<td>286,500</td>
<td>42%</td>
<td>36%</td>
<td>-13%</td>
<td>-14%</td>
<td></td>
</tr>
</tbody>
</table>

#### Number and Percentage of cases (NO₂)

- **209,100** → **142,000** (Attributable Cases)
- **27%** → **18%** (of all asthma cases)

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**Percentage of childhood asthma incident cases due to pollutant by year**

- **NO₂**
- **PM₂.₅**
- **PM₁₀**
Urban vs Rural

<table>
<thead>
<tr>
<th></th>
<th>AC</th>
<th>% of all asthma cases</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000</td>
<td>2010</td>
<td></td>
</tr>
<tr>
<td><strong>NO&lt;sub&gt;2&lt;/sub&gt;</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>184,500</td>
<td>127,500</td>
<td>-31%</td>
</tr>
<tr>
<td>Rural</td>
<td>24,600</td>
<td>14,500</td>
<td>-41%</td>
</tr>
<tr>
<td><strong>PM&lt;sub&gt;2.5&lt;/sub&gt;</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>200,100</td>
<td>158,200</td>
<td>-21%</td>
</tr>
<tr>
<td>Rural</td>
<td>47,000</td>
<td>32,000</td>
<td>-32%</td>
</tr>
<tr>
<td><strong>PM&lt;sub&gt;10&lt;/sub&gt;</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>270,100</td>
<td>240,800</td>
<td>-11%</td>
</tr>
<tr>
<td>Rural</td>
<td>61,100</td>
<td>45,700</td>
<td>-25%</td>
</tr>
</tbody>
</table>

Percentage of all asthma cases (NO<sub>2</sub>)

- **30% vs 15%** (Urban vs Rural - 2000)
- **20% vs 10%** (Urban vs Rural - 2010)
DataTEEH
Datahub for Transportation, Emissions, Energy, & Health
Center for Advancing Research in
Transportation Emissions, Energy, and Health
A USDOT University Transportation Center

https://carteehdata.org/library/webapp/trap-asthma-usa
Discussion – Key Findings

- Up to **142,000** of childhood asthma cases attributable to TRAP in 2010
- **18%** of all asthma cases attributable to NO2
- Urban areas > Rural areas
- 2010 < 2000 burden, due to air pollution levels
- Future analyses is focusing on:
  - Exploring impact of median household income
  - Using state-specific rather than national asthma incidence rates
  - Comparing year 2020 with 2010 and 2000
2<sup>nd</sup> CARTEEH Symposium

Transportation, Air Quality, and Health Symposium

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MAY 18–20, 2020

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