STRUCTURAL RACISM, UNHEALTHY HOUSING, AND ASTHMA DISPARITIES

ELIZABETH C. MATSUI, MD MHS
Professor of Population Health and Pediatrics
Director, Center for Health and Environment: Education and Research
Associate Director, Health Transformation Research Institute
Associate Chair of Research, Department of Population Health
Dell Medical School, The University of Texas at Austin
“Inner-city” Childhood Asthma

- Inner cities are low-income areas in the center of cities
- Racial/ethnic minoritized people often comprise majority of residents
- Asthma prevalence rates 25-28% in some low income, urban neighborhoods

Source: National Hospital Discharge Survey, CDC National Center for Health Statistics, *First-listed diagnosis, #Age-adjusted to 2000 U.S. population
The Built Environment in Low-income Neighborhoods in Baltimore
Environmental Exposures and Asthma

Matsui, J Resp Dis 2006
German Cockroach Allergen Exposure & Asthma Morbidity in Children in Low-income, Urban Neighborhoods

Hospitalizations

Unscheduled Medical Visits

Change in Care Giver’s Plans

<table>
<thead>
<tr>
<th>neg skin test, low allergen exposure</th>
<th>neg skin test, high allergen exposure*</th>
<th>pos skin test, low allergen exposure</th>
<th>pos skin test, high allergen exposure*</th>
</tr>
</thead>
</table>
| Bla g 1 > 8 U/gram
Mouse Allergen Highest in Homes in Low-income, Urban Neighborhoods

<table>
<thead>
<tr>
<th></th>
<th>Median Kitchen Mus m 1 (μg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suburban Maryland</td>
<td>0.007</td>
</tr>
<tr>
<td>US sample (Cohn JACI 2004)</td>
<td>0.36</td>
</tr>
<tr>
<td>NCICAS (Phipatanakul JACI 2000)</td>
<td>1.6</td>
</tr>
<tr>
<td>High poverty, highly segregated neighborhoods in Baltimore</td>
<td>14.7</td>
</tr>
</tbody>
</table>

- Detectable in air of 80-90% of bedrooms
- 25% homes with levels similar to occupational levels
- ~50% with significant asthma sensitized to mouse
Mouse allergen exposure & sensitization associated with:

- asthma morbidity in Baltimore preschool children
  
  Matsui Annals Asthma Allergy Immunol 2006

- symptoms, hospitalization in multi-center study of children living in low-income urban neighborhoods

  Pongracic et al Annals Asthma Allergy Immunol 2008

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78. Mouse urine is a major cause of asthma for poor kids in Baltimore.
Mouse Allergen and Asthma Intervention Trial

- 1 yr RCT
- Intensive professionally delivered mouse integrated pest management
- 5-17 yo in Baltimore or Boston
- Persistent asthma with recent exacerbation
- Sensitized to mouse
- Highly exposed (dust concentration of mouse allergen)

Randomization

Screening CV & HV

Education

IPM & Education

IPM Modules delivered if persists/recurs

NIAID-funded through U01
Clinical Site/Core Leaders: Matt Perzanowski; Wanda Phipatanakul
Both IPM & Education Groups had reductions in symptoms, morbidity

No difference between groups in clinical outcomes or mouse allergen exposure measures

Both had ~70% reductions in home mouse allergen levels

EC Matsui and coauthors

Effect of an Integrated Pest Management Intervention on Asthma Symptoms Among Mouse-Sensitized Children and Adolescents With Asthma: A Randomized Clinical Trial

Published online March 6, 2017
### Predicted Change in Asthma Symptoms and Morbidity for 90% Reduction in Mouse Allergen

<table>
<thead>
<tr>
<th></th>
<th>no. per person-year (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acute visits</strong></td>
<td>-0.82 (-1.13, -0.48)</td>
</tr>
<tr>
<td><strong>ED visits</strong></td>
<td>-0.42 (-0.60, -0.15)</td>
</tr>
<tr>
<td><strong>Hospitalizations</strong></td>
<td>-0.07 (-0.14, 0.02)</td>
</tr>
</tbody>
</table>

*effects estimated from random effects models of relationships between log2(mouse allergen) and asthma symptoms and morbidity; statistically significant findings indicated in bold*

Childhood Asthma Management Program: budesonide associated with 0.1 fewer urgent care visits, and 0.02 fewer hospitalizations per person-yr
Reducing mouse allergen associated with improved lung growth

- ~75% of children with asthma have abnormal lung function when they reach adulthood
- ~10% meet criteria for chronic obstructive lung disease

Children who have reduction in mouse allergen exposure have 75-100ml mls greater lung function growth (FEV1)

Grant T et al, JACI 2020
Disseminating Results: Mouse IPM Educational Video

Community Advisory Board

Produced and directed by Jessica Crowell
https://youtu.be/CFC06uGzY40
What Have We Learned?

A large reduction in indoor allergen levels is feasible & likely necessary to achieve significant clinical benefit
- Control, morbidity
- Long term outcomes, including lung function growth

Targeting a single allergen is promising
- *Population-based interventions*

But
- For mouse, many children (~40%) still had allergen levels associated with morbidity
  - WHY?
Structural Racism, Environmental Equity & Asthma

1910  1930s-1960s  2017

Average Investment per Community (CSA) by % Households below Poverty Line (Amounts in Thousands)

- Low Poverty Neighborhoods (<20% Households below Poverty Line): $13,827
- Moderate Poverty Neighborhoods (20-40% Households below Poverty Line): $11,008
- Concentrated/High Poverty Neighborhoods (>40% Households below Poverty Line): $3,529

Percentage of population with one or more hospitalizations for asthma, by Zip code, 2013-2015:
- 0% - 2%
- 2% - 4%
- 4% - 5.7%

Sources: Capital News Service/Kaiser Health News analysis of Maryland Health Services Cost Review Commission data for 2013-2015, Census Bureau

https://nextcity.org/daily/entry/baltimore-reckons-legacy-redlining
Mobility Asthma Project

Background
- 1995 lawsuit (*Thompson v. HUD*) found that HUD had violated fair housing laws
- Settlement set aside special housing vouchers for assisted housing to help families move to non-poor areas

Prospective cohort study of children with asthma enrolled in the Baltimore Housing Mobility Mobility Program
- To determine the effect of moving from a high poverty to a low poverty neighborhood on indoor environmental exposures and asthma morbidity

Potentially more potent intervention with health care payment and housing policy implications

Co-PIs: Craig Pollack & Corinne Keet
Sponsor: NIEHS
Association between moving to an ‘opportunity’ neighborhood and lung function growth

- Moving associated with improvements in symptoms and reductions in pest allergen levels
- Moving associated with 66mLs greater increase in FEV1
- FEV1 reaches peak in early adulthood, loss of 25mLs per year
- FEV1 is predictor of
  - COPD
  - mortality

![Graph showing FEV1 levels over months since move](chart)
...But Inhaled Corticosteroids Work Well

ICS Benefits
- Highly effective
- At low doses, reasonable side effect profile

ICS Limitations
- Don’t alter natural history of asthma
- Risk of significant side effects at high doses
- Don’t appear to have significant in vivo effects on IgE

Busse et al. NEJM 2011
But....

medications don’t have to be cost effective – why do we hold non-drug management approaches to a different standard?
Austin-Travis County, TX
## Children in Austin-Travis County are more likely to be hospitalized for asthma than US children

<table>
<thead>
<tr>
<th>Asthma-Related ED Visit and Hospitalization Rates (per 10000 py)</th>
<th>PBIR [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>US*</td>
</tr>
<tr>
<td>Emergency Department Visits</td>
<td>74.3 [47.8, 100.8]</td>
</tr>
<tr>
<td>Hospitalizations</td>
<td>10.7</td>
</tr>
</tbody>
</table>


Poverty, Ethnic Composition, and Asthma ED Visit Rates

- Asthma ED visits, population-based incidence rates
- Expressed per 10,000 person-years
- Data source: THCIC
- National PBIR ~55 per 10,000 py
Kids in Travis County have 60% higher rates of asthma events, Dell Medical School study finds

**Nicole Villalpando** Austin American-Statesman
Published 7:02 a.m. CT Oct. 29, 2021

In Dell Medical School’s asthma study, the concentration of emergency room and hospital visits for asthma-related incidents can be seen along census tract lines, with red having the highest concentrations and yellow being the least concentrations. Contributed by Dell Medical School.

TRAVIS COUNTY

Children with asthma in Travis County hospitalized more than children nationwide, study shows

by: KXAN staff
Posted: Oct 21, 2021 / 03:28 PM CDT / Updated: Oct 21, 2021 / 03:28 PM CDT
Structural Racism in Austin-Travis County

Evolution of a ‘Negro District’

In Austin, the strategy to isolate minorities came in the form of the Koch and Fowler city plan, which in 1928 proposed the creation of a “Negro District” — making it the only part of the city where African-Americans could access schools and other public services.

Koch and Fowler also proposed that the district have the city’s weakest zoning restrictions, allowing the development of “a number of slightly objectionable industrial uses” — essentially, any use that wasn’t specifically outlawed.

Structural Racism in Austin-Travis County cont.

- Anglo neighborhoods with zoning protections
- Minority neighborhoods without zoning protections
  - East Avenue
Latinx Communities and Air Pollution Sources are Co-located in Central Texas

Figure credit: Kerry Kinney
The Texas Home Assessment of Asthma and Lung Exposures (TexHALE)

TexHALE is a cross-sectional study of children, 5-17 years of age, with asthma recruited from high poverty and low poverty neighborhoods in Travis County.
Take home messages

Mouse infestation in Baltimore (and similar cities)

• Mouse allergen is a major driver of asthma morbidity among children in Baltimore (and other similar cities).
• Mouse allergen levels can be reduced, and reduction is associated with marked improvements in asthma.
• Allergen exposure reduction linked with long-term benefits, especially lung function growth.

Housing discrimination

• Mouse infestation appears endemic, may be related to history of housing discrimination, limiting effectiveness of mouse infestation interventions.
• Housing mobility may offer an alternative approach that addresses housing discrimination as root cause.
Take home messages, cont.

Austin/Travis County, TX

• Children in Travis Co, TX have a high burden of asthma morbidity, including Latinx children who are predominantly of Mexican origin.

• Poverty, asthma ED visits, and ethnic composition all spatially correlated with each other and with air pollution sources.

• This spatial correlation appears rooted in structural racism related to segregation and zoning ordinances.
Connecting Environment to Health in Texas & Beyond

CHEER is a hub for multidisciplinary environmental health sciences research and education. Housed within the Department of Population Health at Dell Medical School, the center brings together experts from the Cockrell School of Engineering, the College of Natural Sciences, the College of Pharmacy, and the Steve Hicks School of Social Work at The University of Texas at Austin.

Director: Elizabeth Matsui, MD MHS
Steering Committee: Kate Calder, Lydia Contreras, Catherine Cubbin, Andrea Gore, Kerry Kinney, Cory Zigler
Environmental Health is a discipline that focuses on how the environment influences human health and disease.

“Environment” encompasses the natural environment, which includes air, water, soil, and climate, and the built and social environments.
CHEER: Connecting Environment to Health in Texas and Beyond

MISSION:
To improve the health of people locally and globally through research and education.
Expertise

• Statistics and Data Science
• Social Science
• Toxicology
• Endocrine disrupting chemical exposures
• Airway epithelial cell models
• Outdoor air pollution
• Built environment
• Indoor environment
• Allergens and microbial exposures
• Health disparities
• Pediatrics

• Environmental justice
• Respiratory disease
• Neurodevelopment
• Animal models
• Epidemiology
• Water systems
• Building science
• Climate change
• Unconventional oil and gas drilling exposures
Current Activities

- Monthly seminar series
- DMS Medical Student Environmental Health Interest Group (EHIG)
  - Op-eds
  - Journal club
- Internship in Environmental Health Communication
  - Newsletter: Environmental Health Connections
- Community engagement
  - City of Austin Office of Sustainability
  - Collaboration with CEHE, BASTA
  - Climate Change Symposium, Sierra Club of Texas

Sampling of research projects, underway and planned
- Mapping asthma ED visits
- Estimating effects of pollen and viruses on asthma ED visits in Texas
- HUD filter forensics: using HVAC filters to measure indoor environmental contaminants
- Study the effects of unconventional oil and gas drilling emissions in Texas on respiratory health
- The Texas Home Assessment of Asthma and Lung Exposures (TexHALE): Understanding the effects of neighborhood poverty on indoor and outdoor airborne exposures and asthma phenotypes
- Developing an environmental data portal for Central Texas
Endocrine-Disrupting Chemicals and the Brain

By Andrea C. Gore, PhD
Professor and Vacek Chair of Pharmacology and CHEER Steering Committee Member

Effects of the Environment on Children’s Health

By Leo Trasande, MD MPP
Jim G. Hendrick, MD Professor and Vice Chair, Department of Pediatrics
Chief, Division of Environmental Pediatrics
Professor of Environmental Medicine & Population Health
NYU School of Medicine

Public Health Impacts of Air Pollution Regulations by Dr. Cory Zigler

This talk outlines the relevance of air pollution regulations for public health and outlines analytic strategies that combine statistics, epidemiology, and atmospheric science towards quantifying the downstream health impacts of air quality policies.

Molecular Effects of Air Pollution on Airway Epithelial Cells

By Lydia Contreras, PhD
Associate Professor
Jim and Barbara Miller Endowed Faculty Fellowship in Chemical Engineering and CHEER Steering Committee Member
Future Activities

• We are an officially designated Organized Research Unit (ORU) –
  • Thanks to generous support from DMS, CNS, Engineering, and OVPR

• Look for expansion of our work to include activities designed to:
  • catalyze environmental health science research
  • support the development of environmental health science researcher pipeline
  • create a community of EHS researchers and educators across UT
  • engage with the Austin-Travis County community
Want to learn more?

• Sign up for our listserv - contact Rosemary Stewart
  • Newsletter
  • Seminar announcements
  • Announcements of new initiatives and opportunities to get involved

• Feel free to reach out if you’d like to talk!

Email:

cheer.health@austin.utexas.edu
Thank you

- **Study Participants**
- **Community Advisory Board**
- **Collaborators & mentees**
  - Matt Perzanowski
  - Wanda Phipatanakul
  - Roger Peng
  - Bob Wise
  - Corinne Keet
  - Craig Pollack
  - Meredith McCormack
  - Rebecca Zarate
  - Cory Zigler
  - Torie Grant
- **CommUnityCare, Eda Baykal-Caglar, Tara Greendyky**
- **Courtney Mulligan, Becky Correa, Marissa Alviar, Lizzy Keiger, Luis Alamo-Rivera**
- **RA Zarate, Dan Katz, Emily Croce, Michelle Zhang, Torie Grant**
- **Susan Balcer-Whaley, Michelle Newman**

**Sponsors**: NIAID, NIEHS

Contact Information:
email: ematsui@utexas.edu
twitter: @elizabethmatsui

Podcast on Academic Life: The Effort Report
effortreport.libsyn.com
twitter: @theeffortreport
Co-host: Roger D. Peng
Black/African American children in Austin-Travis County may be more likely to be hospitalized for asthma than Black/African American US children.

| Asthma-Related ED Visit and Hospitalization Rates for Black/African American Children PBIR [95% CI] |
|-----------------------------------------------|-----------------------------------------------|
|                                               | US                                            | Travis County                                |
| ED                                            | 254.4 [216.0, 292.8]                          | 268.4 [253.7, 282.8]                         |
| Hosp                                          | 33.3 [8.0, 58.6]                              | 44.3 [38.5, 50.8]                           |
| per 10,000 person-years                       |                                               |                                             |
Spatial distribution of asthma-related ED visits varies by race/ethnicity
Home environmental interventions: What about costs?

Medication Costs

- **fluticasone/salmeterol**
  - 500/50 = $275/month = $3300/y
  - 250/50 = $215/month = $2580/y
  - 100/50 = $175/month = $2100/y
- montelukast = $125/month = $1500/y

Cost of environmental intervention (Morgan et al NEJM): ~1500 dollars/family