Asthma Disparities in the United States

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Why Is This Important?

Asthma is the #1 admission diagnosis in children’s hospitals. Despite NHLBI guidelines for Diagnosis and Management, disparities persist in prevalence, mortality, and morbidity among children, minorities, and the poor.

Disclosures

- Novartis – Speaker, Trainer, Independent Contractor, Honorarium
- Boehringer Ingelheim – Advisory Board and Speaker, Honorarium
- ThermoFisher – Speaker, Honorarium

Patterns of Asthma Prevalence
**Background: Prevalence**

Since 2000, asthma prevalence has grown 12.3% to 8.2% of the overall population, most notably in:

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>African-American</td>
<td>13.5%</td>
</tr>
<tr>
<td>Asian</td>
<td>9.2%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>9.6%</td>
</tr>
<tr>
<td>White</td>
<td>17.5%</td>
</tr>
</tbody>
</table>

**CDC/NHCS**

**Background: Utilization**

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED visits</td>
<td>15%</td>
</tr>
<tr>
<td>Hospitalizations</td>
<td>19%</td>
</tr>
<tr>
<td>Total ED visits</td>
<td>29%</td>
</tr>
<tr>
<td>Total Hospitalizations</td>
<td>38%</td>
</tr>
<tr>
<td>Total ED visits + Hospitalizations</td>
<td>48%</td>
</tr>
</tbody>
</table>

**Source:** 2018 National Asthma Education Program.
**How Do We Explain These Differences?**

**Gene-Environment Interactions in Asthma Development**

**Culture and Ethnicity**

**Environment**

**Genetics**

**Early Intermittent Asthma**

**Culture and Ethnicity**

**Environment**

**Genetics**

**Chronic (Persistent) Asthma**

**Culture and Ethnicity**

**Environment**

**Genetics**

**Susceptibility**:
- Asthma, atopy, bronchial hyperreactive, genetics
- Cultural practices, prenatal maternal influences, allergens, respiratory infections, tobacco smoke, pollutants, prematurity, dietary factors

**Expression**:
- Disease severity, pharmacogenetics
- Reversible and irreversible changes in airway structure and function

**The Urban Environment**

- Higher intake of snacks, fast food, sweetened beverages
- Less availability of fresh fruit and vegetables, dietary sources of omega-3 fatty acids

**Traffic-Related Air Pollution (TRAP)**

- TRAP is a collective concept including:
  - Carbon monoxide
  - Ultrafine particles
  - Ozone
  - Nitrogen dioxide
  - Black carbon
  - Sulfide dioxide
  - Other lesser-mentioned pollutants

**Asthma risk increased in 2497 children (age range 4.8-9.0 years) in prospective study in USA with modeled TRAP exposure from roadways near:***
- Homes (HR: 1.51 [1.25-1.81]; p < 0.001)
- Schools (HR: 1.45 [1.06-1.98])
Traffic-Related Air Pollution

- Of estimated 320,500 asthma cases, 8% were partially caused by proximity to a major road
- Positive link between asthma exacerbations and proximity to major roads
- 3.6% reduction in the proportion of children living within 75 m of a major road would result in 990 fewer asthma cases
- 3.6% increase would result in an additional 990 asthma cases

Other factors:
- Traffic-related Air Pollution
- Other factors

Inner-City Indoor Allergen Exposure

- National Cooperative Inner-City Asthma Study (NCICAS)
  - 83.3% of homes had detectable cockroach allergens
  - 36.8% of patients had positive skin test to cockroach allergen
- Exhibiting cockroach sensitivity plus the presence of high levels of allergen in the bedroom were associated with:
  - Increased hospitalizations
  - Increased emergency department visits
  - Increased days with wheezing

Trends in Urbanization

- Urbanization has occurred in all major areas, yet Africa and Asia remain mostly rural

Proposed Policy Impacting Health Disparities

H. R. 482

IN THE HOUSE OF REPRESENTATIVES

March 2, 2011

Mr. Price (for Mr. Berman), Mr. Kucinich, Mr. G. Murphy, and Mr. G. Davis of South Carolina, Mr. Davis of Tennessee, Mr. Scott of South Carolina, Mr. Thompson, Mr. Hultgren, Mr. Thompson of Missouri, Mr. G. Thompson of Maine, Mr. Fleischmann, Mr. Mathias, Ms. Matsui, Mr. Thompson of Oregon, Mr. Perdue, and Mr. Fleischmann introduce the following bill, which is referred to the Committee on Financial Services:

Text of proposed bill as introduced in the House of Representatives:

The text of the proposed bill as introduced in the House of Representatives is not available.
Allostasis and Allostatic Load

What is allostasis?
The process of achieving stability, or homeostasis, through physiological or behavioral change. This can be carried out by means of alteration in HPA axis hormones, the autonomic nervous system, cytokines, or a number of other systems, and is generally adaptive in the short term.

Allostasis is essential in order to maintain internal viability amid changing conditions.

What is allostatic load?
Allostatic load is “the wear and tear on the body,” which accumulates as an individual is exposed to repeated or chronic stress. It represents the physiological consequence of the body’s stress response that results from repeated or chronic stress.

Allostatic load is a framework used to explain how frequent or chronic activation of the body’s stress response can result in physiological wear and damage, with negative consequences for health and function.

Association of Allostatic Load Biomarkers and Asthma in Adolescents

Prospective follow-up of children enrolled at 7 to 10 years, from rural and urban areas. Allostatic load index was derived from eight markers:
- Fasting glucose
- Total cholesterol
- High-density lipoprotein cholesterol
- Dehydroepiandrosterone sulfate
- Cortisol
- Systolic and diastolic blood pressure
- Waist to hip ratio

Boys

<table>
<thead>
<tr>
<th>High allostatic load</th>
<th>Crude OR (95% CI)</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.70 (1.01 - 7.23)</td>
<td>0.33 (0.11 - 1.04)</td>
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</tbody>
</table>

Girls

<table>
<thead>
<tr>
<th>High allostatic load</th>
<th>Crude OR (95% CI)</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.29 (0.68 - 2.46)</td>
<td>0.74 (0.36 - 1.50)</td>
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Perceived Racial/Ethnic Discrimination and Asthma Severity

- SAGE II Enrollees
- Self-reported perceived racial/ethnic discrimination in 49% of enrolled
- 78% greater risk of asthma
- Increased bronchodilator responsiveness
- Higher TNF-alpha levels
- Decreased responders to controllers
- Severe Asthma endotype characterized by poor asthma control
- Relation of allostatic load to asthma severity via inflammatory and neuroendocrine mechanisms that lead to severe asthma endotypes
Interaction Between Genes and Social Environment

- Disparities may result from variations in genes and their interaction with the environment.
- Genetic pathways are involved in regulation of inflammation and catecholamine response regulating neurotransmitters, such as (SNS).
- Children of low SES over-express genes that regulate activity stress response and wound healing.
- Children of higher SES over-expressed genes that may be involved in containing damage caused by inflammation.
- SES may thereby have an effect on children's interpretation of their social world, which may alter neurotransmitter and inflammatory signaling processes.
- Inflammatory and catecholamine pathways are primary targets for asthma medications.

Might the social environment modify the efficacy of asthma therapy in some populations?

Racial Differences in Physiologic Parameters of Asthma

- Compared with a matched cohort of European-American children with asthma, middle-class African-American children with asthma had:
  - Decreased forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV₁).
  - Increased airway responsiveness.
  - Increased total serum immunoglobulin E (IgE) levels.

Racial Differences in Atopy

- Sensitization to allergens:
  - Puerto Rican children were at a significantly higher risk for multiple indoor and outdoor allergies compared to White children.
  - African-American children were twice as likely as White children to be allergic to mixed tree pollen, mixed grass pollen, ragweed and mugwort/ sage.
  - Among all children, outdoor allergy predicted a higher degree of overall allergen sensitization.

Prevention Strategies and Improved Diagnosis

- Allergy skin or RAST testing should be performed more often as part of management of asthma in certain children.
**Asthma Predictive Index in Children**

<table>
<thead>
<tr>
<th>Major criteria</th>
<th>Minor criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental MD asthma</td>
<td>MD allergic rhinitis</td>
</tr>
<tr>
<td>MD eczema</td>
<td>Wheezing apart from cold</td>
</tr>
<tr>
<td>Eosinophilia (≥4%)</td>
<td></td>
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</tbody>
</table>

**PROs:**
- Developed using mixed ethnicities
- API is simple to use and can rule out the likelihood of asthma by school age in young children with wheezing

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**β-Agonist Receptor Response to Treatment**

- Chronic exposure to β-agonists results in loss of receptor expression (desensitization of receptor response)
- ~50% of this is due to genetics
- There are three non-synonymous polymorphisms of the β2 adrenoreceptor coding region
  - Two out of three have an impact on downregulation of receptor number
  - Some studies point to a subpopulation (those homozygous for Arg16) that does not appear to benefit from chronic β-agonists

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**Pharmacology and Role of Long-Acting Muscarinic Antagonists (LAMAs)**

- LAMAs such as tiotropium preferentially block M3 receptors
- LAMAs avoid the potential problem of increased prejunctional release associated with SAMA
- May prevent adrenergic response to chronic exposure with IABA

**Potential synergistic effect between LAMAs and LABAs**

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**Health Belief Model**

Beliefs influence willingness to follow preventive, therapeutic recommendations

- "The threat to my health is serious"
- "I am susceptible to this health problem"
- "The benefits of the recommendation outweigh the costs"
- "I am confident in my ability to carry out recommended actions successfully"
Beliefs and Self-Efficacy

Research in psychology shows that when you believe you can do something successfully—
- You do it more often
- You are more persistent in the face of difficulty

Many families lack confidence that they can carry out provider recommendations and effectively manage an asthma attack at home.

Self Determination in Healthy Behaviors

- Self determinism is an individual’s belief that they are capable of completing a task and reaching a set goal.
- Self determinism (or self efficacy) measured by a validated scale (KASE) is low in urban blacks with asthma.

Enhanced Asthma Education: One Incomplete Answer

Published comparative effectiveness studies of asthma education show:
- Baseline asthma knowledge is low in high risk groups
- Education does increase knowledge, but does not consistently improve asthma outcomes

If knowledge cannot be applied to specific situations, behavior does not change.

Bandura’s Social Cognitive Theory

Determinants of Improved Self Determinism
- Mastery experiences (practice opportunities)
- Social modeling (watching others succeed)
- Social persuasion (from a trusted source)
- Psychological response (decreased stress)
Not One More Life (NOML): Novel Approach to Asthma Disparities

NOML programs presented in partnership with communities of faith, health ministries, local schools and other validated community partners.

Individual case management:
- Referral to existing clinics and community hospitals
- Medication assistance
- Access to pulmonologists, allergists
- Determination of eligibility for CMS programs
- Enrollment of patient insurance programs

One Potential Solution

- Established 2003
- Community based programs of education, screening, counseling, referral and outcome monitoring
- Model expanded to 19 other US cities
- Online patient and provider education (CME) on asthma management, live CME in selected cities
- Monthly community Pulmonary Clinic

NOML: Novel Approaches

NOML programs presented in partnership with communities of faith, health ministries, local schools and other validated community partners.

- Short didactic presentation on asthma, Q&A
- Participants screened: validated (modified Juniper) questionnaire and spirometry
- Pulmonologists/staff and PCC volunteers review results with participants
- Feedback to PCP and/or specialty providers
- Access to specialty care via community pulmonary clinic
- Telephonic follow-up at 1, 3, 6 and 12 months

Our Partners
Why Communities of Faith?

* Enduring bases of leadership
* Roles in fostering community well-being
* Strong visions for spiritual and physical health of their faith communities
* Well-developed Health Ministries staffed by members committed to fostering health in their congregations

ASTHMA

What Do you Know?

What Is Asthma?

* Difficult breathing caused by blocking air flow through the breathing tubes.
* Due to squeezing of breathing tubes caused by different things.
* This squeezing can be fixed.

Your Lungs Give You the Breath of Life

* Your lungs bring air into the body——getting oxygen to the blood.
* Your lungs breathe air out of the body——taking bad air out of the blood.
Asthma is a Lung Disease that makes your airways tight

- Airways get tight and squeezed
  - By swelling
  - Tightening of airway muscles
  - Filling with mucus

Asthma Triggers

- Cockroaches
- Mice and Rats
- Indoor mold
- Tobacco smoke
- Exercise or Playing Hard
- Cold air

What Makes Me Short of Breath?

- The lungs' defense mechanisms cause the problems.
  - Airway swelling (inflammation), muscle tightening (bronchospasm) and excess mucus trap the bad air in the lung.

If you control your asthma, you can do anything

- Rev. Jessie Jackson - Minister, Activist
- Jackie Joyner-Kersee - Olympian
- Karl Malone - Professional Basketball Player
- Jerome Bettis - Professional Football Player
One-on-One Counseling

Community

Personalized Education
Each Visit Should Leave a Legacy of Empowerment Sustained by Partnership

NOML: Screen Results
- 167 NOML Onsite Events
  - Metropolitan, Atlanta, GA
  - October 2003 – July 2014

The NOML team captured and recorded 87% of all participants’ data

The NOML team captured and recorded 87% of all participants’ data

NOML: Screen Results

| Age (yrs) | Mean: 36 ± 20 yr | Median: 39 yr |

Only 23.7% self-reported asthma, but 50% have increased symptoms or abnormal lung function!

NOML: Screen Results

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Female</th>
<th>African-American</th>
<th>BMI &gt; 30 kg/m² (obese)</th>
<th>Ever used tobacco</th>
<th>Current tobacco users</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>66.7%</td>
<td>73.6%</td>
<td>33.6%</td>
<td>23.7%</td>
<td>7.1%</td>
</tr>
</tbody>
</table>

Low Symptom Score and Normal Lung Function
17%

High Symptom Score and Normal Lung Function
35.6%

Low Symptom Score and Abnormal Lung Function
8.9%

High Symptom Score and Abnormal Lung Function
38.5%

Poor perceivers?

Poorly controlled
NOML: Under-treatment & Utilization Participants with Established Asthma

- No current asthma treatment: 38%
- Bronchodilator only: 27%
- Inhaled corticosteroids: 19%
- Ever hospitalized for asthma: 21%

Drew-Freeman Middle School
Suitland, Maryland, March 2014 NOML Program

At School (n= 201)
- 14% diagnosed with asthma (3.9% national average)
- 32%, with increased symptoms or abnormal PFRs suggestive of asthma
- 40%, previously prescribed ICS/MDI

Students Diagnosed with Asthma (n = 32)
- 20% with history of asthma hospitalization
- 88% had been prescribed ICS/MDI
- 77% had been prescribed a controller
- 50% had been prescribed an inhaled corticosteroid

Strategies to Change the Paradigm

Increase adherence
- Effectively improve and engage parents and patients in the importance of medication adherence

Uncover barriers to adherence
- Ambivalence
- Fear and misinformation
- Cost
- Relapse factor

Address the barriers
- Straight talk
- Eliminate victim mentality
- Education
- Support, patient assistance, financial assistance
Treatment considerations to decrease global burden of asthma:

- Community-based interventions
- Phenotyping and development of personalized intervention strategies
- Risk of exposure
- identification of asthma susceptibility genes and environment interactions
- Education, education, education

Prevention strategies and improved diagnostic algorithms:

- Urbanization (TRAPEZ, suboptimal immune system priming and increased indoor allergen exposure)
- Genetics (racial differences, polymorphisms, family history, maternal influences)
- Variability of β-agonist responsiveness and utilization
- Allergic load

Asthma drivers:

- Urbanization (TRAPEZ, suboptimal immune system priming and increased indoor allergen exposure)
- Genetics (racial differences, polymorphisms, family history, maternal influences)
- Variability of β-agonist responsiveness and utilization
- Allergic load

In Memory of Kellen

February 9, 1990 - January 11, 2001

"Not One More Child"