INDOOR AIR TRIGGERS FOR PEDIATRIC ASTHMA

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PREVALENCE

• Prevalence of asthma:
  – Adults: 5%
  – Children: 10-15%

• Prevalence of atopy:
  – Adults: 20%
  – Children: 10-20% (increasing with age)

• Prevalence of atopy in asthmatics:
  – 70-80%
Pathophysiology

• Interactions between environmental and genetic factors result in airway inflammation

• Airway inflammation limits airflow and leads to functional and structural changes in the airways
  – bronchospasm
  – airway wall edema
  – mucus production

• Airway obstruction causes increased resistance to airflow and decreased expiratory flow rates.
  – lead to a decreased ability to expel air and may result in hyperinflation.
Increased frequency

- **In the US:** 17.3 million Americans have asthma.
  - Prevalence of asthma in the general population is 5%
  - increased 40% in the past decade
  - accounts for more school absences and more hospitalizations than any other chronic illness
  - In children's hospitals, it is the most common diagnosis

- **Worldwide,** 130 million people have asthma.
  - Prevalence is 8-10 times higher in developed countries (US, Great Britain, Australia, New Zealand)
  - In developed countries, the prevalence is higher in low income groups in urban areas and inner cities
THE HYGEINE HYPOTHESIS: The cleaner we are, the more asthma!

- Leading theory explaining the increase in allergic diseases in the past 2 decades
- Explains higher incidence of asthma and allergies in developed countries
- Explains lower incidence of asthma in children raised on farms
- Explains decreased incidence of asthma in infants who begin daycare early in life
The hygiene hypothesis
Why are there more allergic individuals?

- Th2 T cells drive the immune response towards allergy, Th1 cells do the opposite
- Early infant immune response shifted towards Th2
- Exposure to microbes and endotoxin shifts to Th1 response
Inflammation in asthma

Normal

Asthma

Eosinophils

BM
INDOOR ENVIRONMENTAL FACTORS

• Development of asthma
• Trigger for acute attack

• Americans spend 87% of time indoors
  – Exposure to allergens
  – Exposure to particulates/non allergen triggers
INDOOR ALLERGENS

- Dust mites
- Pets
- Pests (rodent, ant, cockroach)
- Mold
- Food and drug
- Latex
NON ALLERGIC INDOOR TRIGGERS

- Tobacco smoke, vapor, marijuana
- Particulates: dust, construction/remodeling, indoor wood fire
- Fumes, solvents, pesticides, indoor cleaning chemicals
- Strong smells, perfumes, cooking fumes, NO2 from gas stoves
- Essential oils
**Bathrooms**
showers, plumbing leaks, household cleaners, wastebaskets, drinking cups, damp carpeting and flooring, bacteria and viruses

**Living Areas**
tobacco smoke, furniture and carpeting, pets, wood stoves and fireplaces, hobby supplies (such as varnishes and glues)

**Bedrooms**
poor ventilation, dust and dust mites, bacteria and viruses, pet dander, drycleaning

**Attic**
old clothing and bedding, old asbestos insulation, dust

**Garage**
paints and solvents, auto exhaust, pesticides and herbicides, gasoline fumes, old newspapers

**Yard**
pollen, dust, pesticides and herbicides

**Kitchen**
cooking smoke, gas appliances, household cleaning agents, garbage pails, plumbing leaks
ROLE OF ALLERGIC SENSITIZATION IN DEVELOPMENT OF ASTHMA

• Linear relationship between levels of house dust mite antigen in homes and development of asthma at 5 yrs of age

• Children with positive skin test for allergies at 18 mos had higher risk of asthma at age 5

• Infants exposed to high levels of cat allergen had lower risk of subsequent wheezing
TIMING OF SENSITIZATION

- Critical window: birth to 8 years
- Correlates with development of asthma
DUST MITE ALLERGY

- Microscopic in size
- Thrive in temps of 68-77 F and 70-80% humidity
- Feed on human skin
- Allergen is waste product of mites
- Do we have them in Nevada
Dust mites and molds are generally not found in home environments with less than 40% humidity.

There is a low prevalence of dust mite in desert areas.

Evaporative coolers are only efficient when the relative humidity is low, thus restricting their effective use to very dry climates.

Evaporative coolers raise the indoor humidity and may permit growth of dust mites and molds.
Reno, NV is in the high desert, with very low average humidity. Swamp coolers are very popular in this area due to their low energy costs.
12 of 19 homes with evaporative coolers (63%) were positive for mite allergen. Compared to 5 of 19 (26%) control homes were positive (p < 0.05).
## Results: Dust Mites

<table>
<thead>
<tr>
<th></th>
<th>Patients with Evaporative Coolers</th>
<th>Patients without Evaporative coolers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent with at least one positive skin test to at least one dust mite species</td>
<td>$34%^*$</td>
<td>$21%$</td>
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</table>

*Chi-square = 6.2, p-value = 0.013*
DUST MITES: HOW TO AVOID

- Normal vacuuming doesn’t work: vacuum with HEPA filter helps
- Cover mattresses/pillows
- Wash bedding weekly in hot water (>130F)
- Avoid carpets, wool blankets, upholstery
- Reduce humidity in home
  - Dehumidifier
  - Air conditioning
MOLD ALLERGY

• In desert climate:
  – Spores released in dry/windy weather
  – Farm/barn environments
  – Indoor mold a bigger problem
  – Swamp coolers!

• Avoidance:
  – Reduce dampness in bathrooms/basements
  – Use air conditioning
  – Don’t use swamp coolers!
## Results: Molds

<table>
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<th>Patients with Evaporative Coolers</th>
<th>Patients without Evaporative coolers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent with at least one positive skin test to any mold</td>
<td>42%*</td>
</tr>
</tbody>
</table>

*Chi-square = 10.5, p-value = 0.002.*
PET ALLERGY

• 60% of Americans in contact with dogs/cats
• 15-30% of people with asthma or allergies are allergic to cats/dogs
• Allergen is in dander, saliva, urine: NOT hair
PET ALLERGY: ADVICE

• Total avoidance best
• If not possible:
  – Remove carpets/upholstery
  – Use HEPA filter in vacuum cleaner, HEPA air filters
  – Bathe pets weekly
  – Don’t handle litter
  – KEEP OUT OF BEDROOM
COCKROACH ALLERGY

• Cause of frequent hospital admissions in inner city children with asthma
• 23-60% of urban residents with asthma are skin test +
• Allergen in feces, saliva and bodies
• They hide well: if one roach seen, 800 more hidden!
• Treat with poison baits, boric acid, traps
• NOT with chemical agents
ENVIRONMENTAL TOBACCO SMOKE

• Contains up to 400 chemicals and >40 carcinogens
• Linked to asthma symptoms and asthma causation
• Exposure during pregnancy linked to development of asthma in child
• Causes lower resp. tract infections
• Nevada threatening to cut ALL funding to youth smoking cessation programs!
21st CENTURY INHALANTS

• Electronic vapor products
  – Nicotine, VOCs and other chemicals

• Essential oils
  – VOCs
  – Direct inhalation of oils can cause severe pneumonia

• Legal marijuana
  – Needs more study
HOME REMODELING

• Particulates/dust from wood, drywall, etc.
• Volatile organic compounds (VOCs) from: plaster, drywall, particle board, plywood, paint, resin, varnish, rubber solvents, sealants, wallpaper, vinyl floors, carpeting, drapery, etc.
• Asbestos: older homes <1970’s
HOME REMODELING TIPS

• Hardwood ideal
• Use “low volatile” varnish/wax and paints
• Leave home for a few days
• Ventilate home for a few days before returning
• Professionally clean before returning
• Use HEPA air filters
DO AIR FILTERS WORK?

- Probably helpful: HEPA filters built into central heating/air
- Mechanical filters: fan driven HEPA filters
  - Trap particulates, pollens, mites
- Ion type electronic filters: use electric charges to attract allergens and irritants
- These free standing systems have mixed results
- Vacuum cleaners with HEPA filters helpful
DOES REDUCING ALLERGEN EXPOSURE EARLY IN LIFE PREVENT ASTHMA?

• House dust mites:
  – Decreased house dust mite levels
  – Improved outcomes at early ages

• Not across the board for all allergens

• Some studies show decrease in severity or symptoms as opposed to prevention of disease

• Lack of effect vs. inability to reduce allergen load enough
Thank You