“Green” vs. Conventionally Built Housing: an Environmental Comparison

Joyce Witt, MPH, RN
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Background

Public Health Goals

DHHS Strategic Plan 2007 -2012

Protect Life, Family, and Human Dignity
Background

Healthy People 2010

CDC Health Protection Plan
Healthy People in Healthy Places
Aim of Study

- Assumption: Green building design reduces allergens and toxic substances within the home.

- Goal: to obtain science-based evidence of the benefits of green vs. conventional building.

- Specific goal: to pilot the methodology for a national study of health effects and possible economic benefits of “Green” vs. conventionally constructed housing.
Study Green Criteria

- Advanced Framing
- Fresh Air Intake
- Right-size HVAC (Manual J Calc)
- Moisture Protection Measures
- Energy Star Appliances
- Recycled Content Products
- Waste Management
Methodology

- **Objective:** To quantify levels of allergens, fungi, pesticides and volatile organic chemicals in “green” and conventionally built housing.

- **Hypothesis:** There is a difference in exposures to select allergens, fungi, pesticides, and volatile organic chemicals between “green” and conventionally built housing.
Methodology - Demographics

- **Study Design** - Cross-sectional
- **Sample** – Convenience, Atlanta
  - 2 Senior-citizen independent housing complexes

- **Green complex**
  - Built in 2003
  - 84 units
  - Residents
    - age: 64-90
    - n = 33

- **Conventional complex**
  - Built in 1978
  - 195 units
  - Residents
    - age: 55-97
    - n = 40
Methodology (cont’d)

Data Collection

- Interviews: participants, property managers
- Maintenance records – units and property
- Visual assessments of units
- Environmental sampling
- List of household cleaning products
Methodology (cont’d)

Environmental Sampling

- Allergens and fungi
  - Vacuum dust

- Pesticides
  - Isopropanol wetted gauze

- Aldehydes and VOCs
  - Passive air diffusion badges
Methodology (cont’d)

**Environmental Sampling**

- **Allergens**
  - Dust mites: Der p 1, Der f 1
  - Cockroach: Bla g 2
  - Rat: Rat n 1
  - Mouse: Mus m 1

- **Volatile Organic Chemicals**
  - Formaldehyde
  - Acetaldehyde
  - Other

- **Pesticides**
  - Chlorpyrifos
  - Cypermethrin
  - Additional pesticides

- **Culturable Fungi**
RESULTS
Allergens – Cockroach

- Cockroach allergen
  - “Green”: 2/31 units (6%)
  - Conventional: 0/34 units
Mouse and Rat Allergens

- **Mouse (Mus m 1)**
  - "Green"  7 of 31 units  (23%)*  (chisq p =0.07)
  - Conventional  2 of 34 units  (6%)

- **Rat (Rat n 1)**
  - "Green"  1/31 units  (3%)
  - Conventional  0/34 units

- Pest Management, Building Layout, Location
Of all homes, 85% had detectable Der p 1 or Der f 1

Der f 1 was the predominant dust mite allergen.
- Detectable Der p 1 = 43% (28/65)
- Detectable Der f 1 = 83% (54/65)
Dust Mite Allergens

*Level associated with symptoms

*Level associated with sensitization

*Concentration displayed on log scale.

**Error bars represent 1 unit increase in geometric standard deviation.
Indoor Allergen Levels

National Survey of Lead and Allergens in Housing

- Dust mite allergen – detected in 84% of homes
- Cockroach allergen – detected in 63% of homes
- Mouse allergen – detected in 57% of homes

*Study conducted by NIEHS and HUD*
Pesticides

- Chlorpyrifos – Found in 6 conventional units.
- Banned in 2000 for homeowner use.
Limitations, Challenges

- Difficulty obtaining control group
- Disparate age, layout of housing
- Data collection inconsistencies
Result Reporting

- Meet with property managers
- Town Hall Meeting
  - explain aggregate results
- Separate responses
  - ambient / below threshold
  - require follow-up
- Offer health resources
Lessons Learned

- Obtain housing – meet with decision-maker
- Ample training time for reinforcement
- Strong communications with investigators
- Pilot questionnaire/sampling in homes
- Close oversight of labeling
Collaboration

Georgia State University
John Steward
Melanie Alexander
Ashley Edwards
Dr. Karen Gieseke
Hannah Ross-Suits

ZAP Asthma, Inc.
Yvette Samuels
Lisa Reid  Marie Sanders
Thelma Malone  Bonita Cox

Technical Oversight by CDC
Dr. Mary Jean Brown  Dr. Ginger Chew
Dr. Chinaro Kennedy  Dr. Antonio Neri
Paris Ponder  Marcia Griffith
Barry Brooks  LaFreta Dalton
Joyce Witt
Green Housing Study
Team Members
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The Public Health Impact of Greening Affordable Housing

Presented by Jill Breysse
National Center for Healthy Housing

2008 National Healthy Homes Conference ❖ September 15-17, 2008 in Baltimore, MD
Project Partners

Research Team
- National Center for Healthy Housing (NCHH)
- Center for Sustainable Building Research (CSBR)
- Southwest Minnesota Housing Partnership
- Greater Minnesota Housing Fund

Research Funding
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Pre-Rehab Building Description

- Worthington, MN
- Mostly subsidized rentals
- 60 units in 3 buildings
- Constructed in 1974
Before and After Renovation
Green Rehab Elements

- Low-VOC adhesives, paints & coatings
- Radon testing pre- and post-rehabilitation
- Ventilation: ASHRAE 62.2
- Pest management: Contracted with firm specializing in IPM
- Non-smoking common areas
- No carpet in wet areas
- Energy-Star fans exhausted to exterior equipped w/humidistat
Kitchen Renovations
Community Amenities
Data Collection and Training

- Health Questionnaire
- Visual Assessment
- Resident Training
- Building Performance Testing
- Radon Testing

You Can Take 7 Steps to KEEP Your House a Healthy Home

1. Keep it dry.
2. Keep it clean.
3. Keep it pest-free.
4. Keep it ventilated.
5. Keep it safe.
6. Avoid contaminants.
7. Keep it maintained.
Resident Characteristics

- Winter celebration
- 30 of 54 occupied units enrolled
- 29 adults, 30 children
- Residents in 18 units had lived in renovated apartments <1 month; 12 lived there 2 to 9 months
- 6 adults & 2 children with history of asthma
Baseline Questionnaire Results

Comfort in Apartment Compared with Old Home (n=30)

- More Comfortable: 70%
- Less Comfortable: 17%
- About the Same: 10%
- Don't Know: 3%
Baseline Questionnaire Results, cont’d

Ease of Cleaning Compared with Old Home (n=30)

- 63% Easier
- 27% About the Same
- 10% Harder

[Legend: Easier, Harder, About the Same]
Baseline Questionnaire Results, cont’d

Amount of Time Children Play Outside Compared with Old Home (n=13)

- 46% Play Outside More
- 23% Play Outside Less
- 23% About the Same
- 8% Don’t Know
Baseline Questionnaire Results, cont’d

Child's Health Compared with When in Old Home (n=30)

- 63% Better Now
- 13% Worse Now
- 23% About the Same
Baseline Questionnaire Results, cont’d

**Adult's Health Compared with When in Old Home (n=30)**

- Better Now: 33%
- Worse Now: 7%
- About the Same: 57%
- Don't Know: 3%

**Legend:**
- Better Now
- Worse Now
- About the Same
- Don't Know
Baseline Questionnaire Results, cont’d

Safety of Building Compared with Old Home (n=30)

- Safer: 40%
- Less Safe: 7%
- About the Same: 50%
- Don't Know: 3%

BUILDING A FRAMEWORK FOR HEALTHY HOUSING
Environmental Testing

- Temperature and Relative Humidity
- Carbon Dioxide Measurements
- Radon: Short-term and long-term
- Total Volatile Organic Compounds (TVOCs)
Radon Testing Results

2 Rounds of Pre-Renovation 3-Day Tests:

- Round 1: 29 kits. Range 1.0-6.8 pCi/L; 9 results at or above 4 pCi/L
- Round 2: 8 kits. Range 2.3-4.0 pCi/L; 1 result above 4 pCi/L
- Average: 3.4-5.2 pCi/L; 5 results above 4 pCi/L

Post-Renovation 90-Day Tests:

- 22 test kits, 17 recovered. Range 0.6-4.5 pCi/L; 2 results at or above 4 pCi/L
Radon Mitigation

CSBR, 2008
Radon Mitigation Impact on Moisture

CSBR, 2008
Ventilation Testing Results

- Fresh air delivered at about 70% of the ASHRAE standard
- Kitchen and bathroom exhaust air flows slightly below and above specified rates, respectively
- Ductwork required more sealing to reduce leakage.
Summary of Results

- Radon testing indicated need for mitigation, currently ongoing
- Noticeable improvements in child and adult health, comfort, safety and ease of cleaning
- Ventilation measurements show fresh air supply, duct sealing and need for improved exhaust ventilation in kitchens and bathrooms-corrective actions completed
Conclusions to Date

- Low-income housing can be renovated using Green and Healthy Homes principles that promote energy conservation, sustainability and public health and safety.
- Ventilation and environmental testing help ensure that building renovation design performs as intended.
- Collaboration of housing, health and environmental professionals is essential.
Ongoing Work

- Follow-up Health Interview and Visual Assessment
- Additional Ventilation System Performance Testing
- Life Cycle Analysis
- Utility Bill Collection: water and utilities
- Property Manager’s Manual
- Training
For More Information:

Jill Breysse  
National Center for Healthy Housing  
jbreysse@nchh.org  
443-539-4155  
www.nchh.org