Testing/Evaluation/Outcomes

To be added.
Currently under analysis.

Air Testing (pre + post)
TVOC, formaldehyde, allergens

Testing/Evaluation/Outcomes

To be added.
Currently under analysis.

Monitoring

Unit temperature, relative humidity, CO2 and CO

Health Outcomes Studies
National Center for Healthy Housing

Weatherization and Rehabilitation of Low-Income Housing Using Green Healthy Homes Techniques Improve Health Outcomes and Indoor Environmental Quality

researchers

David E. Jacobs, PhD, CIH
SL Dixon, J Breysse, J Akoto, L Conroy, S Dorevitch

Green Communities and Health

Studies of Green Housing & Health Outcomes

Conclusions

Health Criteria include:

- ASHRAE 62 & kitchen and bath exhaust ventilation
- No carpet in kitchens/baths
- Low VOC paints/adhesives
- Integrated Pest Management
- Radon testing & mitigation
- Moisture & mold mitigation
- Other

Health Outcomes and Green Renovation of Affordable Housing

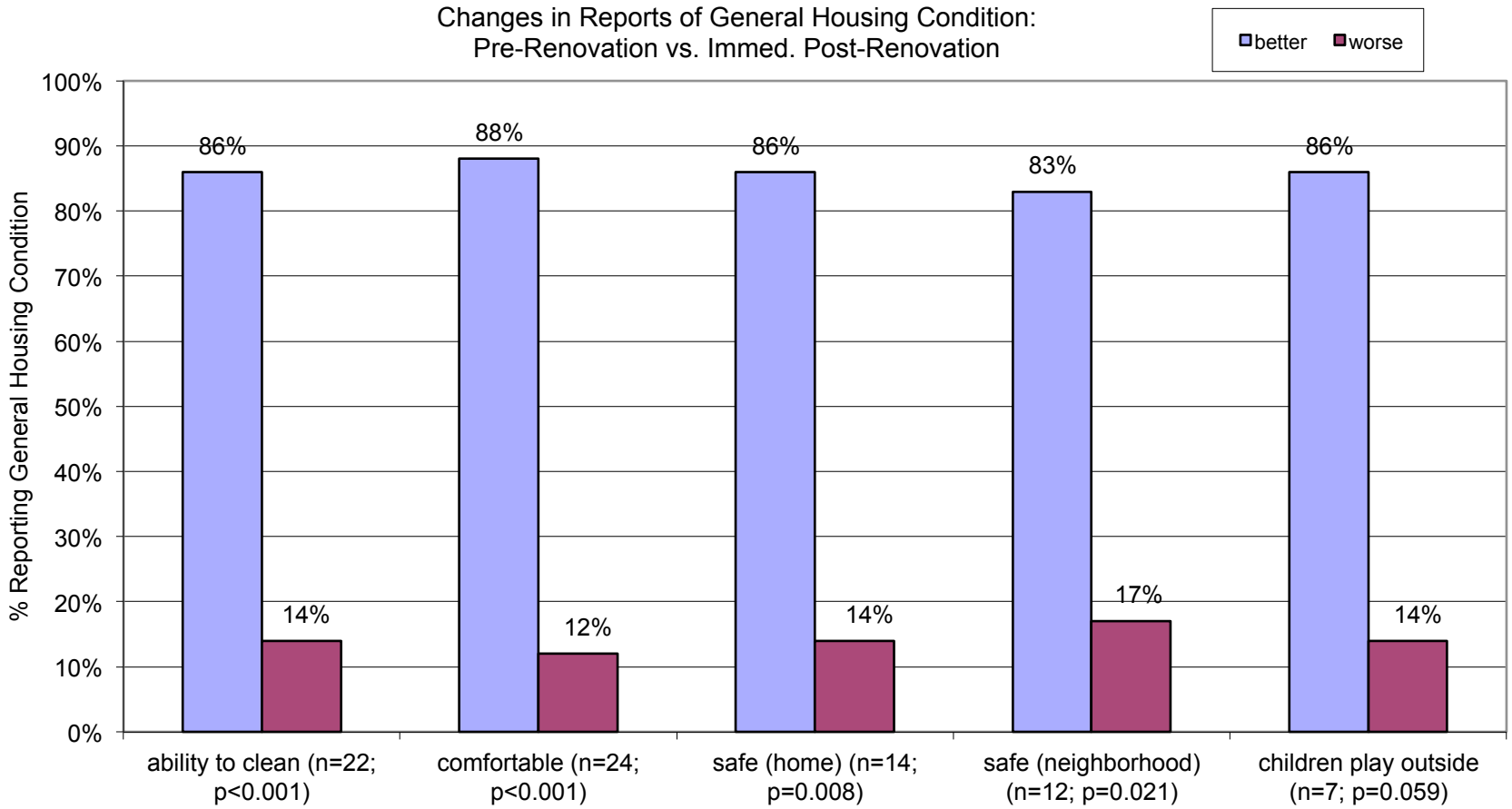
Jill Breysse, MHS[a]
David E. Jacobs, PhD[a]
William Weber, MArch[b]
Sherry Dixon, PhD[a]
Carol Kawecki, MA, RN[a]
Susan Aceti, MSW[a]
Jorge Lopez, BS[c]

ABSTRACT

Objective. This study sought to determine whether renovating low-income housing using "green" and healthy principles improved resident health and building performance.

Methods. We investigated resident health and building performance outcomes at baseline and one year after the rehabilitation of low-income housing using

Results


Changes in Reports of General Housing Condition:
Pre-Renovation vs. Immed. Post-Renovation
better
worse
% Reporting General Housing Condition
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
86%
14%
88%
12%
86%
14%
83%
17%
86%
14%
ability to clean (n=22; p<0.001)
comfortable (n=24; p<0.001)
safe (home) (n=14; p=0.008)
safe (neighborhood) (n=12; p=0.021)
children play outside (n=7; p=0.059)

Adults
(1-year followup)

General health reported as either very good or excellent increased from 33% to 62% (p=0.052)

- Chronic bronchitis 10% → 0% (p=0.025);
- Hay fever (12% → 4% (p=0.046);
- Sinusitis (12% → 2%; p=0.025);
- Asthma (12% → 4%; p=0.046);
- Hypertension (10% → 4%; p=0.083).

Children
(1-year followup)

General health reported as either excellent or very good increased from 53% to 65% (p= 0.286)

- Respiratory allergies decreased from 15% → 4% (p=0.083)
- Ear infections also improved by the same amount (p=0.083).
- Doctor diagnosis of eczema or other skin allergy decreased from 23% → 0% (p=0.083).
- No change in asthma (n=2)

Moisture

Fewer people reported that their newly renovated homes had:

- moisture problems (29% ⟹ 4%; p=0.020)
- evidence of water or dampness due to broken pipes, leaks, heavy rain, or flooding
  - (39% ⟹ 18%; p=0.083)
- a need for either a dehumidifier
  - (24% ⟹ 3%; p=0.014)
- or a humidifier (17% ⟹ 7%; p=0.083).

Pests

Fewer problems with cockroaches

- (17% ➡ 7%; p=0.083).

Lower use of insecticides by residents

- (21% ➡ 4%; p=0.059)

Lower use of insecticides by exterminators or maintenance personnel (37% ➡ 4%; p=0.003)

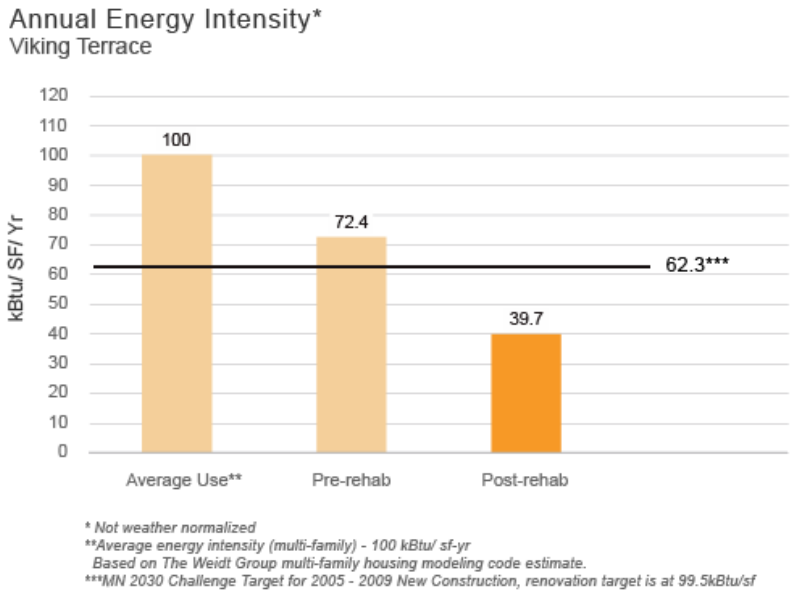
Fewer problems with mice or rats (25% ➡ 0%; p=0.257).

Year-long average CO_2 = 982 ppm

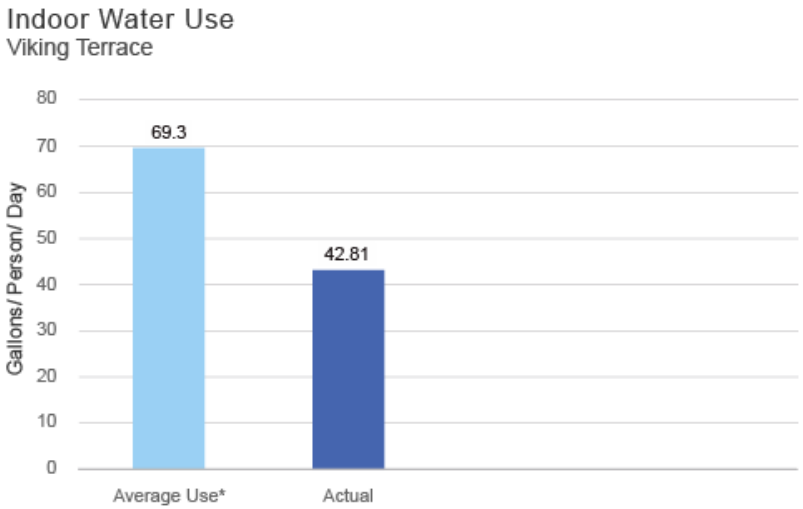
All VOCs below ATSDR minimum risk levels

Energy & Water

1 year follow-up



** Not weather normalized*
***Average energy intensity (multi-family) - 100 kBtu/ sf-yr*
Based on The Weidt Group multi-family housing modeling code estimate.
****MN 2030 Challenge Target for 2005 - 2009 New Construction, renovation target is at 99.5kBtu/sf*



** Average indoor water consumption - 69.3 gal/ person/ day*
Based on AWWA's drinktap.org project, which uses figures from the Handbook of Water Use and Conservation by Amy Vickers, Waterplow Press, 2001.

WATTS TO WELL-BEING

Compared residents' reported health status before and after energy efficiency upgrades

Participants in Boston, New York, and Chicago

Wx measures included insulation, heating upgrade, bath fan installation, window replacement, door weatherstripping, leak repair, health & safety repairs

Watts Results (n=248 households, 1 year follow-up)

0.29 point improvement in the mean general health score (1=excellent, 2=very good, 3=good, 4=fair, 5=poor) (3.07 to 2.78, $p<0.001$).

Sinusitis, hypertension, overweight and reduced use of asthma medication during asthma attacks showed 5%, 14%, 11%, and 20% differentials between improvement and worsening($p=0.038$, $p<0.001$, $p<0.001$, $p=0.077$, respectively).

While 20% improvement in asthma medication, there were two measures of asthma severity that worsened

- days with problems sleeping: differential between improvement and worsening -28%, $p=0.009$;
- frequency of symptoms: differential between improvement and worsening -26%, $p=0.031$).

Adult Health Changes – DC Green Study (Wheeler Terrace) (n=25 households)

			DC Green	
			Pre	Post
General Health Status •Very good or excellent •Good •Fair or poor			 31% 35% 32%	 41% 30% 30%
Injury			14%	4%

Child Health Changes – DC Green

			Pre	Post
General Health Status •Very good or excellent •Good •Fair or poor			 58% 31% 9.5%	 61% 39% 0%
Injury			3%	0%
# ER Visits due to Asthma			14	0

DC Green Results

Apartments had large statistically significant improvements in water/dampness problems (80% at baseline vs. 16% at 1-year post-intervention; $p<0.001$);

Mildew odor/musty smells eliminated (61% vs. 0%; $p<0.001$);

cockroach problems significantly improved (56% vs. 8%; $p=0.003$);

rodent problems significantly improved (64% vs. 12%; $p=0.002$), with resulting reductions in pesticide use;

Allergens, Energy & Water Results

Geometric mean cockroach (Bla g1) and mouse (Mus m1) allergen dust loadings reduced from baseline to 3-months post-intervention ($p=0.002$ and $p<0.001$, respectively)

Sustained at 1-year (both $p<0.001$).

Energy and water cost savings were 16% and 54%, respectively

Highline Communities Results

Study group = Weatherization Plus Community Health Worker
Comparison group= CHW only
(1-year followup)

Outcome	Study Group		Comparison Group		P-value
	Baseline	1-Year	Baseline	1-Year	
% children not well-controlled/very poorly controlled asthma	100%	28.8%	100%	51.6%	0.040
Avg Caregiver Quality of Life score	5.1	6.7	5.3	6.2	0.002
Avg Home Asthma Trigger Score	1.8	0.8	1.2	0.7	0.089

Combining weatherization and healthy homes interventions with Community Health Worker asthma education significantly improves childhood asthma control

Breathe Easy Homes Asthma (Seattle)

Takaro, TK, Krieger J, Song L, Sharify D, Beaudet N. 2011. The Breathe-Easy Home: The impact of asthma-friendly home construction on clinical outcomes and trigger exposure. Amer J Public Health 2011;101(1):55-62.

Health Outcome	Change
Symptom-free days/2 weeks	4.8 fewer days/2 weeks (p=0.004)
Urgent Clinical Care Trips (% reduction)	41.2% (p=0.002)
Asthma Triggers in House Dust	2.0 before/0.03 after
Caretaker Quality of Life Score	4.9 before/5.8 after

GREAT Study
Green Rehabilitation of Elderly Apartment Treatments

- Public housing for the elderly and disabled
- Baseline data completed
- Housing rehabilitation using Enterprise Green Communities Criteria in Minnesota
- One year data collection underway
- First study looking at elderly health and housing outcomes

MIGHHTY, Highline, DC Green, Watts to Well-Being and GREAT Studies

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Conclusion

Using modern green healthy housing principles in low-income housing produces substantial self reported health and housing quality benefits

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Questions

Matthew Casavant
Blumentals Architecture
mattc@blumentals.com

Jorge Lopez
Southwest Minnesota Housing Partnership
jorgel@swmhp.org

William Weber
Center for Sustainable Building Research, UMN
wmweber@umn.edu