Effective Mitigation of Allergen-Induced Asthma

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Disclosures

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- CDC: Green Housing Study U01EH001130

Supplies donated for used in research studies:

- Victor Cockroach Pheromone Traps donated for cockroach collections donated by Woodstream
- Maxforce FC Magnum donated by Bayer Environmental Science, North Carolina USA; (fipronil 0.05%)
- Advion donated by DuPont, Wilmington, Delaware USA; (indoxcarb 0.6%).

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Allergy testing is indicated for patients with persistent asthma in order to counsel on avoidance of allergic triggers

Region 6 respiratory panel

Quest	Labcorp	ARUP
Cat dander	Cat dander	Cat dander
Dog dander	Dog dander	Dog dander
Mouse Urine	**Mouse Urine**	**Mouse epithelium**
D. farinae	*D. farinae*	*D. farinae*
D. pteronyssinus	*D. pteronyssinus*	*D. pteronyssinus*
Cockroach	Cockroach	Cockroach
Alternaria	*Alternaria*	*Alternaria*
Aspergillus	*Aspergillus*	*Aspergillus*
Cladosporium	*Cladosporium*	*Hormodendrum*
Penicillum	*Penicillum*	*Penicillum*
		Mucor
		Milk
		Peanut

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		Mucor
		Milk
		Peanut

Region 6 respiratory panel

Quest	Labcorp	ARUP
Elm	Elm	Elm
Maple	Maple	Maple
Mountain Cedar	Mountain Cedar	Mountain Cedar
Mulberry	Mulberry	Mulberry
Oak	Oak	Oak
Pecan/Hickory	**Ash**	**Pecan/Hickory**
Birch	Birch	Birch
Walnut	**Cottonwood**	**Walnut**
Timothy grass	Timothy grass	Timothy grass
Bermuda grass	Bermuda grass	Bermuda grass
Rough marshelder	Rough marshelder	Rough marshelder
Rough pigweed	**Russian Thistle**	**Rough pigweed**
Short ragweed	Short ragweed	Short ragweed
	Nettle	

Pollen and mold spores

- Early to late spring: Tree pollen
- Late spring to early fall: Grass pollen
- Early fall until cold of winter: Weed pollen
- Mold spores: Spring through fall, fluctuating with humidity

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- FDA approval of sublingual tablets for: grass pollen, ragweed pollen

House dust mites

Gotzsche, PC and HK Johansen. **House Dust Mite Control Measures for Asthma**. 2008. *Cochrane Database Syst Rev*.

54 trials (3002 patients) were included

- 36 trials assessed physical methods (26 mattress encasings)
- 10 chemical methods
- 8 with combination of chemical and physical methods

Results

- AM peak flow:
- Number of patients improved:
- Asthma symptom scores:
- Medication usage:

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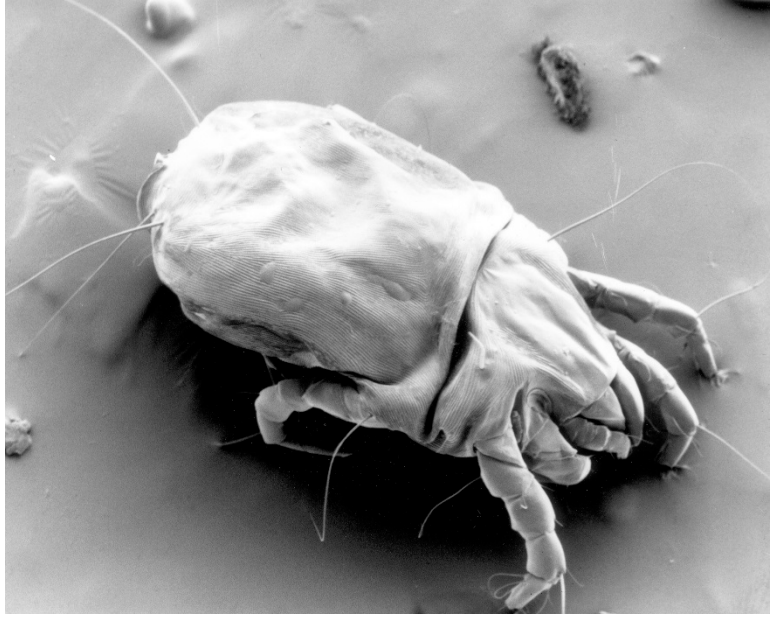
Results

- AM peak flow: Mean difference 0.00, 95% confidence interval (CI) -0.10 to 0.10
- Number of patients improved: relative risk 1.01, 95% CI 0.80 to 1.27
- Asthma symptom scores: standardized mean difference -0.04, 95% CI -0.15 to 0.07
- Medication usage: standardized mean difference -0.06, 95% CI -0.18 to 0.07

Gotzsche, PC and HK Johansen. **House Dust Mite Control Measures for Asthma**. 2008. *Cochrane Database Syst Rev*.



AUTHORS' CONCLUSIONS:

Chemical and physical methods aimed at reducing exposure to house dust mite allergens **cannot be recommended**. It is doubtful whether further studies, similar to the ones in our review, are worthwhile. If other types of studies are considered, they should be methodologically rigorous and use other methods than those used so far, with careful monitoring of mite exposure and relevant clinical outcomes.

But what about preventing…

Rhinitis flares?

Development of rhinitis, eczema, and asthma in the first place?

Arroyave WD, FA Rabito, JC Carlson, FE Friedman, SJ Stinebaugh. **Impermeable dust mite covers in the primary and tertiary prevention of allergic disease: a meta-analysis**. 2014. *Ann Allergy Asthma Immunol*. 112(3):237-48

MEDLINE, Embase, Web of Science, and CINAHL were systematically searched. Seven primary prevention trials (n = 3,461) and 17 tertiary prevention trials (n = 1,671) met the inclusion criteria. All reviews and abstractions were performed in duplicate.

<u>Primary prevention</u>:

- House dust mite sensitization:
- Wheeze:
- Asthma:
- Allergic rhinitis:
- Atopic dermatitis:

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Primary prevention: No significant pooled relative risks were found. The pooled relative risks were:

- House dust mite sensitization: 0.97 (95% confidence interval [CI] 0.62-1.51)
- Wheeze: 0.92 (95% CI 0.81-1.05)
- Asthma: 0.85 (95% CI 0.70-1.02)
- Allergic rhinitis: 1.03 (95% CI 0.90-1.19)
- Atopic dermatitis: 1.05 (95% CI 0.84-1.32)

Arroyave WD, FA Rabito, JC Carlson, FE Friedman, SJ Stinebaugh. **Impermeable dust mite covers in the primary and tertiary prevention of allergic disease: a meta-analysis**. 2014. *Ann Allergy Asthma Immunol*. 112(3):237-48

Tertiary prevention:

- Peak flow:
- Asthma symptoms score:
- Nasal symptoms score:

Arroyave WD, FA Rabito, JC Carlson, FE Friedman, SJ Stinebaugh. **Impermeable dust mite covers in the primary and tertiary prevention of allergic disease: a meta-analysis**. 2014. *Ann Allergy Asthma Immunol*. 112(3):237-48

Tertiary prevention: No significant standardized mean differences were found. The pooled standardized mean differences were:

- Peak flow: -0.03 (95% CI -0.15 to 0.09)
- Asthma symptoms score: -0.06 (95% CI -0.32 to 0.20)
- Nasal symptoms score: -0.39 (95% CI -0.88 to 0.11)

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Conclusion: No evidence was found to support the use of impermeable mattress covers in the primary prevention of allergic disease or in the tertiary prevention of allergic disease symptoms.

So what to do?

- N-95 mask when cleaning or out of area for 30 minutes
- Subcutaneous immunotherapy
- Sublingual immunotherapy (Odactra) (currently for ages 18+)

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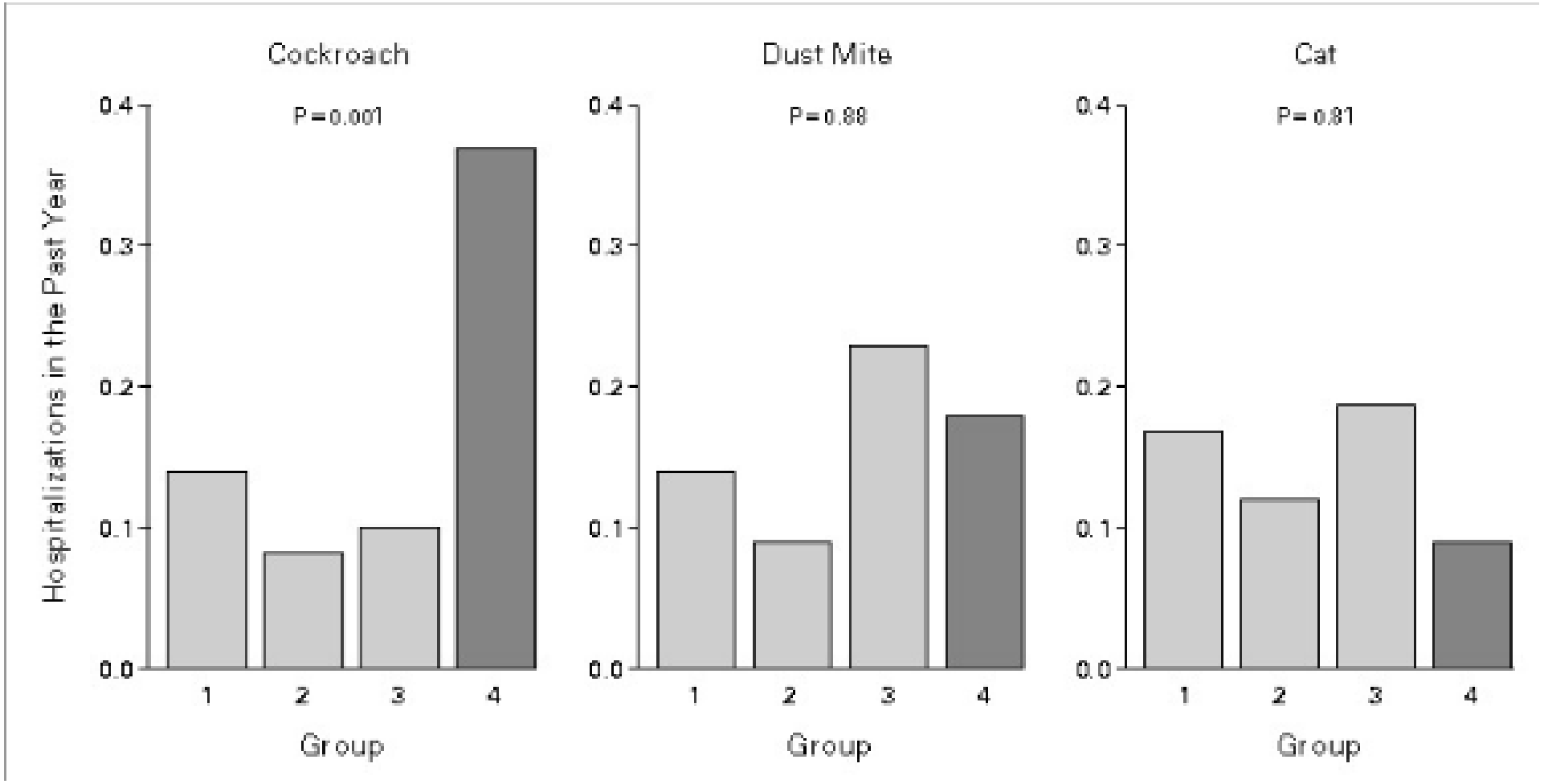
…. If dust mites are actually a driver of disease for this patient

German cockroaches

Rosenstreich DL, Eggleston P, Kattan M, Baker D, Slavin RG, Gergen P, Mitchell H, McNiff-Mortimer K, Lynn H, Ownby D, Malveaux F. **The role of cockroach allergy and exposure to cockroach allergen in causing morbidity among inner-city children with asthma**. *N Engl J Med*. 1997 May 8;336(19):1356-63.



Cockroach exposure independent of sensitization status and association with hospitalizations for asthma in inner-city children

Felicia A. Rabito, PhD*; John Carlson, MD, PhD†; Elizabeth W. Holt, PhD*; Shahed Iqbal, PhD*; and Mark A. James, PhD‡

Background: Children with asthma living in urban environments experience disproportionately high asthma hospitalization rates. Excessive exposure to perennial allergens, including cockroach and house dust mite (HDM), have been implicated, but data are limited.

Objective: To examine the relation between cockroach and HDM exposure and measures of asthma morbidity and health care utilization.

Methods: Participants included 86 atopic asthmatic children living in New Orleans, Louisiana. Sensitization status was determined by means of serum specific IgE testing, and vacuum dust samples were collected for allergen analysis. Logistic regression analysis was used to assess the odds of persistent wheezing, emergency department visits, and asthma hospitalization in those with high vs low levels of allergen exposure.

Results: Approximately 44% and 40% of children were exposed to Bla g 1 levels greater than 2 U/g and HDM levels greater than 2 μg/g, respectively, and 24% reported at least 1 hospitalization in the previous 4 months. The median Bla g 1 level was significantly higher in the homes of children hospitalized compared with those with no hospital admissions (7.2 vs 0.8 U/g). In multivariable models, the odds of hospitalization were significantly higher in children exposed to Bla g 1 levels greater than 2 U/g (adjusted odds ratio, 4.2; 95% confidence interval, 1.24–14.17), independent of sensitization status. Exposure to HDMs was not associated with any measure of morbidity.

Conclusions: Exposure to cockroach allergen was strongly associated with increased hospitalization in children with asthma. This effect cannot be explained entirely by IgE-mediated inflammation. Controlled interventional trials are needed to determine whether isolated cockroach abatement improves asthma control.

Ann Allergy Asthma Immunol. 2011;106:103–109.

Rabito FA, Carlson J, Holt EW, Iqbal S, James MA. **Cockroach exposure independent of sensitization status and association with hospitalizations for asthma in inner-city children**. *Ann Allergy Asthma Immunol*. 2011. 106(2):103-9.

	OR (95% CI)		
	≥1 ED visit	≥1 hospital admission	≥16 d with wheezing
Exposure			
Bla g 1 exposure >2 U/g	1.80 (0.70–4.7)	**4.53** (1.43–13.80)	3.61 (0.65-19.99)
Der p 1 exposure >2 μg/g	0.70 (0.25–2.01)	1.13 (0.35–3.67)	1.60 (0.37–6.94)
Der f 1 exposure >2 μg/g	0.79 (0.29–2.14)	2.32 (0.79–6.78)	1.31 (0.31–5.60)

Is cockroach bait alone effective enough to affect health outcomes?

Rabito FA, Carlson JC, He H, Werthmann D, Schal C. **A single intervention for cockroach control reduces cockroach exposure and asthma morbidity in children**. *J Allergy Clin Immunol*. 2017 Aug;140(2):565-570.

- Controlled, randomized 12-month interventional trial using cockroach bait applied in homes
- Inclusion
  - 102 children age 5-17 years
  - Diagnosis of asthma, moderate to severe
  - Greater New Orleans residence with most nights in a single home for 1 year
  - Exposed and/or allergic to cockroaches

HUD Healthy Homes Grant LAHH0228-10

Rabito FA, Carlson JC, He H, Werthmann D, Schal C. **A single intervention for cockroach control reduces cockroach exposure and asthma morbidity in children**. *J Allergy Clin Immunol*. 2017 Aug;140(2):565-570.

Outcomes monitored:

- Primary health outcome: mean of the maximum number of symptom days over the previous two weeks defined as the largest value among:
  - days with wheezing, tightness in the chest, or cough
  - days experienced disrupted sleep due to asthma
  - days child had to slow down or discontinue physical activity because of asthma
- Pheromone traps used to monitor number of cockroaches in homes
- FEV1: Not obstructed (≥80% predicted) versus obstructed (<80%)
- FeNO: Inflammation unlikely (<20 ppb) unclear (20-35ppb) and likely (>35 ppb)
- Health care utilization: hospitalizations, ED visits, asthma clinic visits
- Economic measures: # school days missed, # work days missed, medication used

HUD Healthy Homes Grant LAHH0228-10

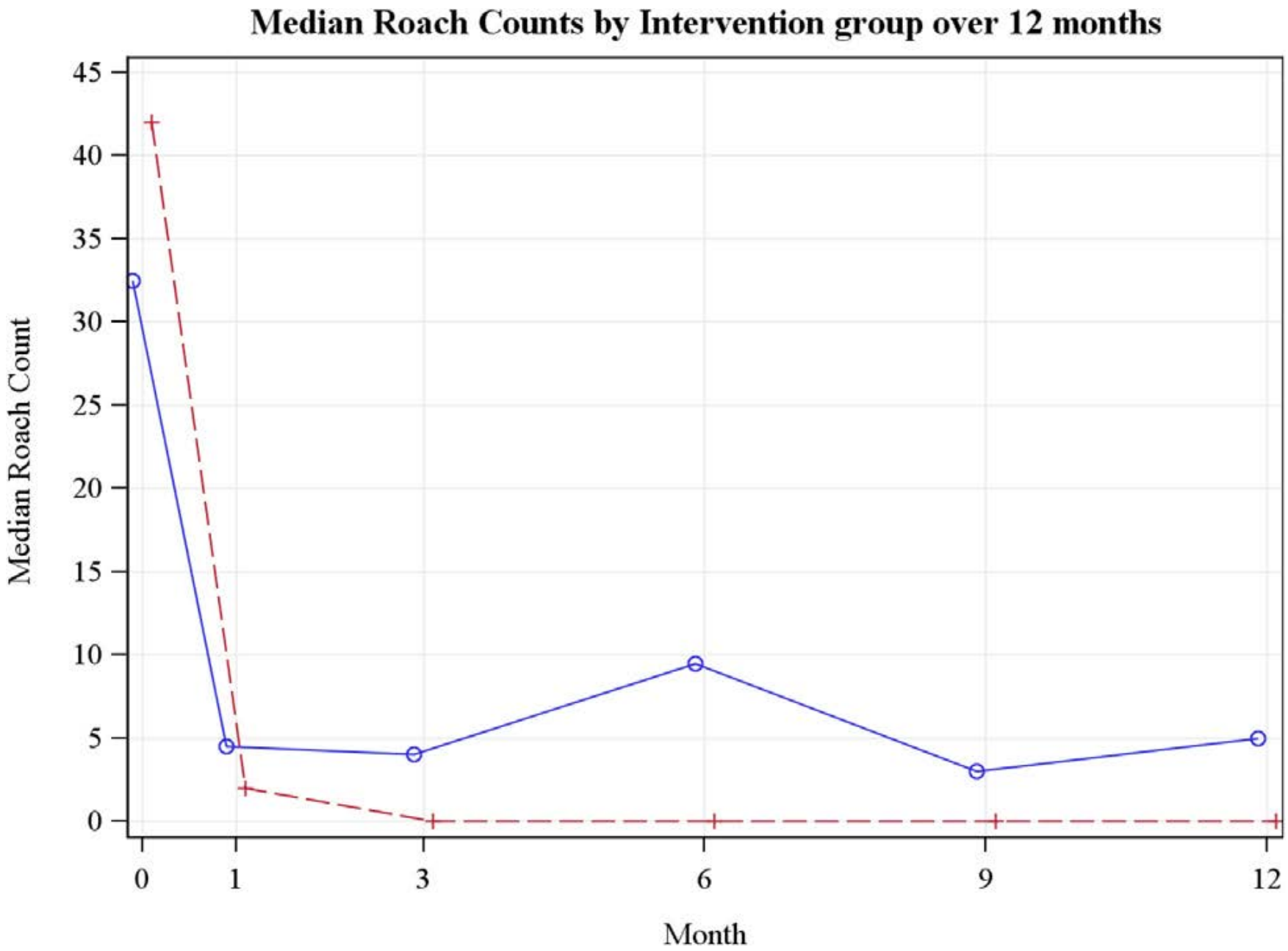

Median Roach Counts by Intervention group over 12 months
Median Roach Count
45
40
35
30
25
20
15
10
5
0
0
1
3
6
9
12
Month

TABLE III. Effect of insecticidal baiting on cockroach counts and asthma morbidity

Variable	Estimate (control vs intervention)		
	β coefficient	95% CI	*P* value
Cockroaches trapped*,†	13.14	6.88 to 19.39	<.01
Mean maximum symptom days*,‡	1.82	0.14 to 3.50	.03
Number of ED/unscheduled clinic visits‡	1.17	0.11 to 2.24	.03
Number of missed school days‡	0.24	−.09 to 0.56	.15
Number of nights caregiver lost sleep‡	−0.01	−0.73 to 0.72	.99

	Odds ratio	95% CI	*P* value
Households trapped ≥30†,§	21.90	1.04 to 462.81	.05
Households trapped ≥1†	25.23	6.27 to 101.50	<.01
Hospitalized‡,§	1.89	0.41 to 8.80	.42
Uncontrolled asthma (ACT score <19)‡	2.50	0.88 to 7.06	.08
FEV_1 <80% predicted‡	5.74	1.60 to 20.57	.01
F_{ENO} ≥20 ppb‡	1.38	0.44 to 4.35	.59

ACT, Asthma Control Test.

*Mean change from baseline to month 12.

†Adjusted for dwelling type and baseline roach count.

‡Adjusted for sex, race, age, and baseline value.

§Firth correction used.

Rabito FA, Carlson JC, He H, Werthmann D, Schal C. **A single intervention for cockroach control reduces cockroach exposure and asthma morbidity in children**. *J Allergy Clin Immunol*. 2017 Aug;140(2):565-570.

Baits applied:

- Maxforce FC Magnum (Bayer Environmental Science, NC; fipronil 0.05%) or
- Advion (DuPont, Wilmington, Delaware; indoxcarb 0.6%).

Combat® Max™ Roach Killing Gel syringe and gel

HUD Healthy Homes Grant LAHH0228-10

American Cockroaches

The Distribution and Movement of American Cockroaches in Urban Niches of New Orleans

Clinical Pediatrics
1–5

DOI: 10.1177/0009922817701169
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SAGE

John C. Carlson, MD, PhD[1], Felicia A. Rabito, PhD, MPH[2], Derek Werthmann, MS[2], and Mark Fox, MS[2]

Abstract

American cockroaches are an important source of household allergens in tropical and semitropical climates. To determine which outdoor niches produce American cockroaches, traps were placed at 40 homes in New Orleans to collect nymphs. Nymphs were collected from the sewers, yards, and within the homes themselves. To compare sewers and yards as sources of cockroaches entering homes, adult cockroaches were collected, marked, and released into yards and sewers. No sewer-released cockroaches were collected in homes. Cockroaches released into yards were collected in the homes, suggesting that yards, rather than sewers, are a more important source niche. A field trial applying boric acid granules to the yard was performed in an effort to reduce entry of cockroaches. There was a significant reduction in the cockroach antigen collected in intervention homes compared with controls.

Keywords

Periplaneta americana, cockroach, asthma, niche, mark-release-recapture, urban pest management

HUD Healthy Homes grant LAHHU0013-13

- The majority of people with cockroach allergy have IgE that binds protein from both species regardless of the species responsible for sensitization. (Schou et al. 1990)

- In warm, humid regions, American cockroaches become the predominant cockroach found in homes and are linked with high rates of allergic sensitization in children (Tungtrongchitr et al. 2004).

Location of traps for indoor and outdoor niches

Kitchen sink	Storm drain (nearest inlet)
Refrigerator	Storm drain (second nearest inlet)
Stove	Sewer line (kitchen)
Food storage	Sewer line (bathroom)
Bathroom sink	Yard debris (near house)
Bedroom	Yard debris (near house)
Under bathroom*	Yard debris (away from house)
Under kitchen*	Yard debris (away from house)

* Cockroaches directly under houses may represent populations that rely on water and food from within the house, similar to cockroaches within walls that are difficult to assay directly. The raised homes found throughout New Orleans enable observations of this niche.

HUD Healthy Homes grant LAHHU0013-13

Table 2. Collection of Cockroaches in and Near Homes.

	Rate of Cockroach Trapping by Species and Developmental Stage					
	American		German		Smokey Brown	
	Adults Per 100 Traps	Nymphs Per 100 Traps	Adults Per 100 Traps	Nymphs Per 100 Traps	Adults Per 100 Traps	Nymphs Per 100 Traps
Indoors	5.53	35.32	6.38	35.32	2.13	2.13
Storm drain	21.74	4.35	0.00	0.00	33.33	1.45
Sewer line	0.00	16.67	0.00	0.00	0.00	8.33
Under house	4.29	15.00	1.42	4.29	5.00	17.86
Yard	15.71	27.14	1.88	6.43	16.25	5.63

Mark-release-recapture

Collection of cockroaches near storm drains/sewers

Marked with fluorescent powder (pink for sewer, blue for yard)

Released within 24 hours of collection into sewer/yard

Recapture traps placed two days after release, set in locations as previously

Monitored every other day for 14 days

HUD Healthy Homes grant LAHHU0013-13

Table 3. Recapture Counts of Marked Cockroaches.

	Recaptured Marked Cockroaches by Location		
Location	Yard Releases Recaptured[a]	Sewer Releases Recaptured[b]	Total Marked Recaptured
Indoors	4 (100.00%)	0 (0.00%)	4
Under home	5 (62.50%)	3 (37.50%)	8
Yard	9 (81.81%)	2 (18.19%)	11
Sewer	0 (0.00%)	45 (100.00%)	45
Total	18	50	68

[a]38 Homes, 1585 roaches.

[b]23 Homes, 872 roaches.

Table 4. Proportion of Homes With Detectable Levels of Bla g 1.

Preintervention[a]				Postintervention[b]			
Group	Bla g 1 Detected (≥0.08 μg/g)	Bla g 1 Undetected	Total	Group	Bla g 1 Detected (≥0.08 μg/g)	Bla g 1 Undetected	Total
Control	7 (43.75%)	9 (56.25%)	16	Control	9 (56.25%)	7 (43.75)	16
Intervention	14 (77.78%)	4 (22.22%)	18	Intervention	16 (88.89%)	2 (11.11%)	18

[a]$P = .08$.
[b]$P = .05$.

JAMA | Original Investigation

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

Elizabeth C. Matsui, MD, MHS; Matthew Perzanowski, PhD; Roger D. Peng, PhD; Robert A. Wise, MD; Susan Balcer-Whaley, MPH; Michelle Newman, BSN; Amparito Cunningham, MD, MPH; Adnan Divjan, BA; Mary E. Bollinger, DO; Shuyan Zhai, PhD; Ginger Chew, ScD; Rachel L. Miller, MD; Wanda Phipatanakul, MD, MS

JAMA. 2017;317(10):1027-1036.

- 361 Children/adolescents randomized to IPM + education or education alone

- Allergen level fell dramatically in both groups
- Asthma improved equally in both groups

- Education alone consisted of:
  - Written materials
  - Demonstration of trap use
  - Demonstration of sealing holes

Recommendations for allergen avoidance

Conclusions

- House dust mite avoidance measures currently available decrease exposure, but are not useful for the prevention of primary or tertiary allergic diseases
- German cockroaches can be eradicated by using insecticidal baits; this does result in improved asthma outcomes
- American cockroaches in New Orleans generally come from outdoors; the importance of this species in clinical disease in the US is probable but has yet to be substantiated.
- Mouse allergen may be reduced with education alone (traps, plug holes); this can improve asthma outcomes

Questions?

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pests

- Pests are yucky and nasty
- Different pests include mice rats and roches
- If you come into contact with a pest call daddy(unless it is a rodent then call the exterminator)
- That is all you need to know

Questions?

John.Carlson@Tulane.edu