

BATTLING CHILDHOOD ASTHMA

A better tomorrow for all of us depends on creating healthy living conditions for children in affordable housing.

BY KIMBERLY VERMEER

While childhood asthma rates nationally are estimated to be 5%–10% of the population, rates in urban neighborhoods of Boston are in the 25% range, and rates among public housing children may be even higher, based on studies by Boston area pediatricians and academics. The Healthy Public Housing Initiative (HPHI), a Boston-based project to improve the health of children with asthma living in public housing by improving their home environment, has completed its initial work. Much of our effort focused on pest control and the reduction of pest-related allergens and asthma triggers.

We found that we were able to reduce or nearly eliminate pest infestations with a combination of resident education, maintenance attention to key repairs, and carefully monitored pest management with the limited application of pesticides. In addition, industrial cleaning reduced much of the residual allergen burden. Children responded to the intervention with improvements in both quality of life indicators such as the ability to play and go to school, and health indicators, such as being able to sleep through the night and wheezing less frequently. Our findings will be of interest to people who work in public or other affordable housing contexts and in communities with older housing stock and a high prevalence of asthma. We also suggest that energy conservation-related work can be planned to address pest and asthma-related building conditions.

Interventions

HPHI objectives and activities were described in detail in earlier articles (see



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Harvard School of Public Health researcher Junenette Peters (left) and Community Health Advocate Linda Hanson collect testing samples in Boston public housing.

“An Opportunity for Healthier Public Housing,” *HE* Nov/Dec '02, p. 42, and “Public Housing Breaks the Mold,” *HE* Sept/Oct '01, p. 24). To review briefly, knowing that environmental triggers in homes can aggravate asthma, we developed interventions for 60 children in participating families in three Boston Housing Authority (BHA) developments. Surveys, visual inspections, and focus groups with residents pointed to pests—especially cockroaches—as a major health and quality of life issue. In response, most of our interventions dealt with pests and pest allergens. Our interventions were as follows:

Limited asthma case management. Our project nurse met with children and their caregivers to assess lung function, to review medication regimens, and to suggest questions to

pose to the children’s primary health care providers. Most of this occurred during a three-month lead-in period with the goal of stabilizing the child’s health, so that improvements caused by the interventions could be isolated.

New mattresses. Children were given new allergy-resistant mattresses donated by Simmons Mattress Company to reduce exposure to dust mites.

Industrial scale cleaning. Heavy-duty vacuuming and steam cleaning was done to remove cockroach frass and other residue—key allergen triggers for many people with asthma—from cabinets and drawers, crevices, radiators and other difficult-to-reach places in the home.

Integrated pest management (IPM). Measures included resident education and support, pest monitoring, targeted pesticide applications, and repairs by

BHA maintenance to implement a strategy of limiting pest access, shelter, food, and water (for more on IPM, see “Integrated Pest Management in the Home,” *HE* Nov/Dec ’04, p. 36). Pest control contractors monitored homes with traps and returned as many times as needed until infestations were under control. They were successful in most homes after one or two visits, but a few homes required four or five visits.

We monitored health and environmental conditions before, during, and after interventions for a period of 9 to 15 months. Health monitoring included intake and outcome questionnaires, lung function tests, allergy testing, and regular tracking of the child and primary caregiver using the Juniper Asthma Quality of Life Questionnaire (AQLQ), to assess well-being and the use of medications and medical services. Families used medical event calendars to report doctor visits or missed school days, and medical intervention incident reports for events such as emergency room visits.

HOBO data loggers were placed in apartments for 8 to 15 months. Environmental monitoring included temperature and humidity; nitrogen oxide levels, as a measure of indoor air quality and exposure to combustion byproducts; and air exchange rates. Dust wipe and vacuum samples were used to evaluate allergen and pesticide exposures. Roach traps were used to estimate infestation levels.

Our project recruited children with asthma, and they reflected the full range of risk factors for asthma:

- 70% of the children had a family history of asthma;
- 56% of the children were overweight (>95th percentile body mass index, or BMI);
- 39% of the families included at least one smoker; and
- 41% of the caregivers did not let children play outside, for fear of street violence.

The severity of asthma was higher than it is in the typical asthmatic population, with 14% diagnosed as severe persistent, 56% diagnosed as moderate persistent, and only 30% diagnosed mild persistent or intermittent.

Other public housing residents were our primary field staff and liaisons to the participating families. Our com-

munity partners, the West Broadway Task Force and the Committee for Boston Public Housing, recruited residents for the Community Health Advocate (CHA) positions. These residents received extensive training in asthma, housing and health connections, integrated pest management strategies, survey methods, and community health outreach work in addition to training in leadership, cross-cultural understanding, and basic job skills.

What We Learned

We evaluated both environmental indicators and health indicators. Our research team members from Harvard School of Public Health, Boston University School of Public Health, and Tufts School of Medicine took the lead in data analysis, but regular team and subcommittee meetings provided forums for presenting, discussing, and interpreting analysis with nonacademic team members.

Air Exchange Rates and Nitrogen Oxide

We monitored air exchange rates and nitrogen oxide (NO_x) exposure for two reasons. First, airborne contaminants exacerbate asthma and nitrogen dioxide is increasingly suspected of amplifying the allergic response to local triggers. We wanted to understand the exposure to airborne triggers, potential interactions with NO_x exposures, and whether existing air exchange rates were adequate to reduce exposures. Second, many BHA apartments do not have exhaust fans. Our original plan called for installing exhaust ventilation in apartments, and these measurements would have been the “before” benchmark for that intervention. Unfortunately, budget, schedule, and coordination issues forced us to give up this plan. Nevertheless the monitoring data have provided useful guidance for future building renovation and energy conservation planning.

Generally, air exchange rates met ASHRAE standards during the summer when households keep their windows open. During the winter, 34% of the apartments were below the ASHRAE 62.2-2003 standards. As one of our BHA partners said in jest, “Great! This

means that 66% of my units meet the standard. Not bad!” We caution, though, that many of these apartments experience serious overheating during the winter and keep windows open year-round. BHA has begun a new round of energy conservation service agreements. As implementation of energy conservation measures moves forward and apartment temperatures drop, more windows will stay closed and more units are likely to be below the ASHRAE standard without the addition of ventilation. This reduction in air exchange can directly affect the buildup of moisture in the home as well as any pollutants being released within the home.

NO_x monitoring highlighted these concerns. In addition to cooking, many families—27% of the total—were using their gas range as a supplemental heat source. This habit was more prevalent in apartments in the development that had completed energy conservation work the previous year, where everyone was still adjusting to the change in temperature. During the heating season, NO_x levels in 40% of the homes exceeded EPA standards. Again, this is a cautionary tale: If energy conservation improvements reduce apartment temperatures and windows stay closed in the winter, how much additional exposure will families have to NO_x if new ventilation is not included in the scope of work?

Allergens

Asthma can be closely related to, or triggered by, allergies. Long-term exposure to allergens has been implicated in the development of allergic response and asthma. Asthmatics who are exposed to allergens to which they are sensitized can experience a flare-up, or exacerbation of symptoms. Other research has shown that cockroach allergy is very common among asthmatic children living in low-income urban areas. Reducing home exposure to dust mites, cockroach and mice antigens, cat dander, and molds can reduce asthma flare-ups if the levels can be reduced, ideally to a point below the exacerbation threshold. (The threshold is an agreed-upon estimate made by researchers, although it differs with indi-

viduals.) We measured allergens using both vacuum and dust wipe sampling methods before, just after, and three months after the apartments had undergone heavy-duty cleaning.

More than 70% of the households had allergen exposures higher than the exacerbation threshold before the cleaning. Kitchen allergen levels went down sharply immediately after the cleaning, and they remained well down even after several months. The average cockroach allergen level dropped by 71% for one type of allergen and by 86% for another. The levels did creep back up from the lowest levels as time went on, and there was wide variation in levels from apartment to apartment. It proved difficult to reduce the allergen levels below the exacerbation threshold immediately after the cleaning (see Figure 1). However, the percentage of families over that level continued to decline over time. Immediately after the cleaning, 62% of families had exposures higher than the exacerbation threshold—a decrease of only 8%; six months later, this figure had dropped further, to 31%.

Overall we considered these results to suggest that cleaning should be part of an effective strategy to reduce allergen exposure. The bad news is that this level of cleaning—pulling radiators apart, using steam cleaners to remove frass and other cockroach residue, vacuuming hundreds of live and dead cockroaches from under ranges and behind counters and cabinets—cost us \$500–\$1,000 per unit, took a full day, and is well beyond the capabilities of most families to accomplish without professional help. The Community Health Advocates helped families pull belongings out of cabinets and closets, helped them discard contaminated food, and encouraged them to reorganize to reduce clutter. It is

hard to see how housing authorities and other owners of affordable housing could bear this cost without outside funding.

Building Conditions

One of the advantages of a project like HPHI is that data collected from sur-

apartments and provide shelter for pests inside the walls. (See “Lessons Shared,” p. 34, for how best to tackle pests.)

Pesticides

When methods used by landlords and pest control contractors do not work to control pests, families take action themselves. In every home we tested, we found evidence of restricted or banned substances that are not used by BHA or its contractors. We found three or four of these substances in most apartments, and in some apartments we found residue from seven (see Figure 2). Use of street products such as Tres Pasitos, or Tempo, a restricted-use product, was prevalent, especially among Hispanic households. Although families reported lower use of these products in the outtake questionnaires, our postintervention sampling showed no reduction in use. We are not sure why this is the case. The testing methods did not distinguish between recent and old exposures. The substances may be so persistent that they remained despite the heavy-duty cleaning. Or families may have been continuing to use the products, but gave the “right answer” when responding to the surveys.

Health Results

Enough about the buildings; what about the children? We had three tools for assessing the effect of living conditions on childhood asthma: The Juniper AQLQ, which the children and their primary caregivers completed every month. Our second tool was the health diaries used to track doctor and emergency room visits, missed school days, and the use of rescue meds. Our third tool was the comparison of the intake and outtake questionnaires.

Quality of Life

The Juniper AQLQ scale measures symptoms, activity limitations, and the emotional function of asthmatics in

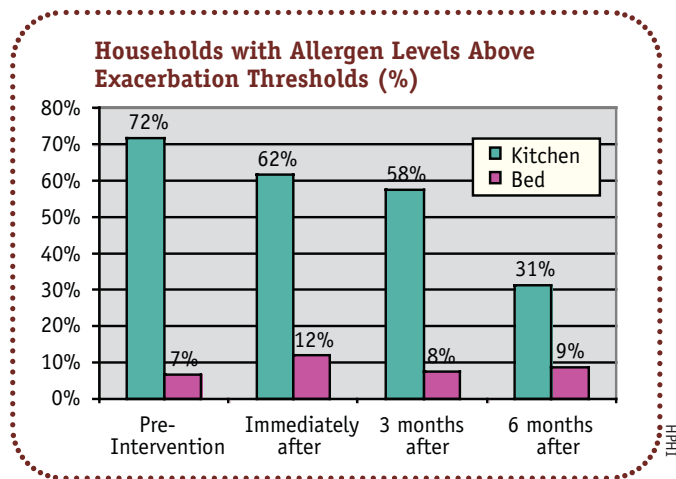


Figure 1. We measured allergens using both vacuum and dust wipe sampling methods before, just after, and three months after the apartments had undergone heavy-duty cleaning.

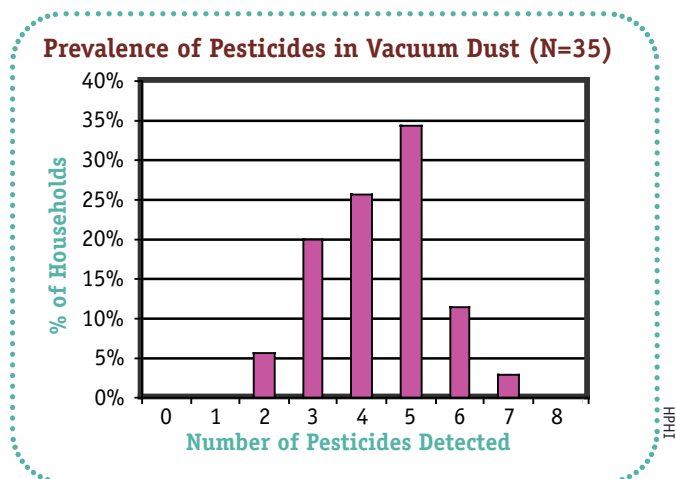


Figure 2. In every home we tested, we found evidence of restricted or banned substances that are not used by BHA or its contractors.

veys and visual inspections can be compared to collected data on environmental conditions and health. One line of inquiry in our study examined the relationship between the observed or reported holes in apartment walls and the presence of pests. This analysis found a strong correlation between these two factors: The homes with the largest holes in walls had the highest incidence of infestations. Holes in walls provide pathways through the building and between

response to the disease. The scores in each component are combined to make up the total score. Overall, the AQLQ scores improved over the course of the project by an amount that is considered clinically significant; in other words, a doctor would notice that the child's asthma had improved (see Figure 3). Scores improved by an average of 0.09 per month on a 7-point scale during the first few months of involvement prior to the interventions. This may be attributable to the asthma health management support we provided. It may also be a reflection of the effect that interaction with project staff had on families that otherwise may have had limited social support networks. The quality of life scores improved by an average of 0.16 per month after the interventions, suggesting that the interventions provided an additional benefit.

The overall score improvements were reflected within the symptoms component. It should be noted that individual children had varying degrees of improvement influenced by other factors, such as age and gender, degree of exposure to second-hand smoking, and perceived stress.

The children's primary caregivers completed the Juniper AQLQ assessments along with the children, and their scores also showed signs of improvement over the course of the project. Not knowing what to do about a child's asthma and watching the child struggle is very stressful for caregivers. Providing tools for managing doctors and medications, providing information and support for taking individual action in their homes, and taking actions that improved the home environment helped to improve the children's health, and increased the well-being of their caregivers.

Health Improvement

Many comparisons of the intake and outcome questionnaires support the conclusion that the children's health, as well as

their quality of life, improved as a result of the interventions. Changes were shown in three key indicators: wheezing, slow-down in activities such as play, and waking up at night (see Figure 4). At the beginning of the project, about 75% of the children reported having problems with wheezing. At the end, this figure had decreased to 40%. Also, the percentage of

bation level in every home, the cleaning did reduce allergen exposure enough to improve the children's health.

We are encouraged by the results of our work. Pests are a huge quality of life and maintenance issue in many urban multifamily affordable housing developments. The pests and the pesticides that are typically used to control them pose a serious health hazard for residents, and management and residents experience frustration when they cannot address the problem. Our project has demonstrated the effectiveness of a three-way partnership between management, residents, and pest control contractors to implement an integrated pest management strategy that reduces infestations, reduces exposure to allergens and pesticides, and improves the health of asthmatic children. Much of what we learned is directly applicable to other public and affordable housing.

Next Steps

The Boston Housing Authority has joined with the Boston Public Health Commission and several other HPHI partners to expand the IPM model that we developed throughout all of BHA's developments. This effort has recently received significant funding from the W. K. Kellogg Foundation. The HPHI model has already been expanded to a large BHA development, where it is meeting with a positive response from residents and a good success rate on reducing pest problems.

As part of our HPHI work, we have developed additional visual inspection tools for the energy service contractor doing the preliminary assessment. BHA has indicated, through its request for proposal process, that it expects health measures—such as new or improved apartment ventilation—to be included in

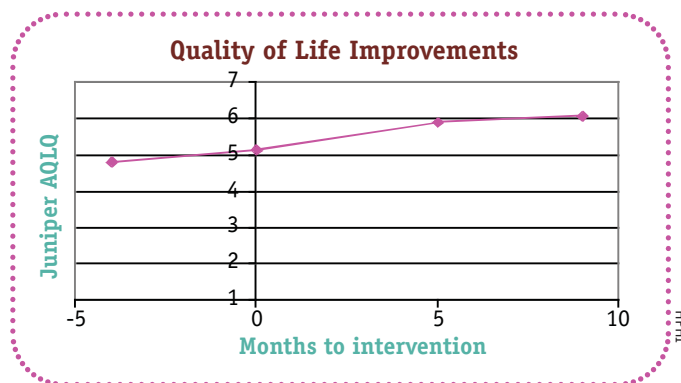


Figure 3. Overall, the AQLQ scores improved over the course of the project by an amount that is considered clinically significant.

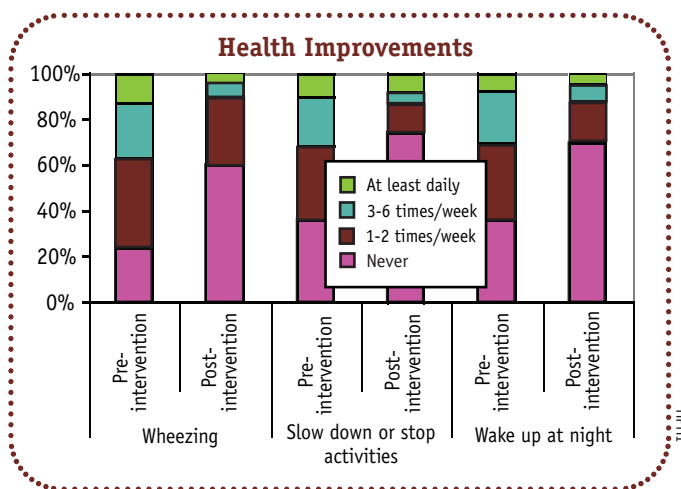


Figure 4. At the beginning of the project, about 75% of the children reported having problems with wheezing. At the end, this figure had decreased to 40%.

children who reported having problems with sleeping, or with having to restrict their activities, dropped by more than half, from nearly 70% to less than 30%.

We also found that reductions in wheezing were positively associated with better than average reductions in bed and air allergen levels. Similarly, improvements in the slowdown in activities indicator were positively associated with better than average reductions in kitchen cockroach allergen levels. These results suggest that even though the cleaning did not achieve the target reduction to below the exacer-

Lessons Shared

Here is what we learned that may help others in public and affordable housing.

Maintenance and Repair

Prioritize the repair of holes and leaks. Reduce pathways into buildings and between units by sealing holes and openings. Prevent or repair leaks; this denies pests the water they need for survival. Key target areas include basement or foundation utility entry points, basement or crawlspace connections to the first floor, and plumbing piping in apartments. Maintenance protocols can add sealing wall penetrations to the standard plumbing work order and add sealing to the unit turnover work list as two means to control pests over time. Interior plumbing leaks can be given a double priority as both a water damage and a pest control problem.

Consider adding industrial cleaning to the work plan for families with documented asthma problems and as part of the apartment turnover protocol. Although eliminating pests is a key first step, it is also necessary to reduce the residual allergen burden, since this residual can trigger asthma attacks. We found that children in apartments where reduction in allergen burden was the greatest experienced the greatest improvements in health. The level of cleaning needed is beyond the capacity of most residents;

this cleaning must be done by the owner of the building.

Tackle pests building by building, not unit by unit. Our project worked with specific families, and we were not able to take a whole-building approach to pest management. Although we had success with individual households and apartments, it was clear that pests move around as long as pathways exist. Without a whole-building approach, we noted reinfestations and increases in allergen exposure as time went on.

Reduce pesticide use by management, contractors, and residents. Managers should eliminate the use of sprays and foggers in pest management programs and require staff or contractors to use traps, baits, and gels instead. Resident education should emphasize the dangers of improper and illegal pesticide use.

Energy Conservation

Evaluate the impact of changes that will result from energy conservation efforts—such as formerly open windows being kept closed—on the indoor environment—for example, on moisture levels and NO_x. Historically, energy conservation experts have focused only on saving energy when planning upgrades. These experts are becoming more aware of the connections between their energy upgrades and the health of residents, but

this issue must still be explicitly factored into assessments and work plans. Energy conservation upgrades may have to require apartment ventilation in order to ensure that energy work will not endanger residents' health.

Use the opportunity of being in apartments to tackle pest-related issues. Clean radiators and seal holes and pathways, and ensure that energy work does not create new pest-related problems. Energy work should never make problems worse, and wherever possible should solve more than one problem.

Residents

Teach residents how to store food, manage garbage, clean, reduce clutter, and use the maintenance work order process. Participating families expressed satisfaction with learning how to take action to reduce pest infestations as part of an asthma management strategy.

Train and employ residents as liaisons between management, residents, and pest control contractors. We found that a three-way partnership was effective when trained residents showed families how to take action and how to prepare for a pest control visit; monitored pest contractor activity; and acted as intermediaries between residents, management, and pest control contractors.

the energy conservation planning. BHA is currently negotiating the final package of energy measures with the energy service contractor. If we can get funding, we hope to continue to work with BHA to evaluate health effects of the energy conservation work.

Whether pest control is a direct activity or an additional focus of routine maintenance and energy conservation work, the reduction of pests and pest-related allergens improves the quality of life and the health of residents. Newer strategies involving IPM and partnerships between residents, management, and pest contractors can increase the success of pest control programs.



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2000 to 2005. She is principal and founder of Urban Habitat Initiatives.

Much of the analytical work was done by Harvard School of Public Health graduate students Jane Clougherty, Junenette Peters, Rhona Julien, and Ami Zota under the supervision of John D. Spengler, Jon Levy, and Gary Adamkiewicz at Harvard and Doug Brugge at Tufts.

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HPHI partners are the Boston Housing Authority and the Boston Public Health Commission (BPHC); the Committee for

Boston Public Housing (CBPH), the West Broadway Tenant Task Force, and the Franklin Hill Tenant Task Force; Boston's three schools of public health at Boston University, Harvard University, and Tufts University; and Peregrine Energy and Urban Habitat Initiatives.

FOR MORE INFORMATION:

This article highlights only a few elements of the HPHI project. Go to the project Web site at www.hsph.harvard.edu/hphi for additional reports, articles, and information or contact Kimberly Vermeer at Tel: (617)624-3930; E-mail: kim.vermeer@urbanhabitatinitiatives.com.