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INTEGRATED PEST MANAGEMENT EDUCATOR PILOT PROJECT

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Abstract German cockroach is the most common pest of urban, low-income housing and is associated with high pesticide use by residents. Cockroach allergen is implicated in asthma exacerbation and initiation and in the growing social and medical aspects of the disease. A safe and secure home environment is an environmental justice issue, and environmentally sound and effective models of cockroach control are needed in public and low-income multifamily housing. One model that offers potential is the integrated pest management (IPM) peer educator model (IPM Educator) in public housing as a component of IPM. A pre-post-analysis of an IPM Educator pilot program in Boston public housing was undertaken. Thirty-four moderate- to high-infested units received baseline assessment and three applications of gel baits and IPM treatment by a pest control operator. Before the first pest control application, residents received written notice to prepare their units for treatment. Before the second and third treatments, an IPM Educator instructed residents in basic pest biology and habits, preparation for treatment, and the role of sanitation in pest control. Results showed a significant improvement in rate of preparation for pest control treatment after the IPM Educator intervention when compared with the preparation rate before the education intervention, and a significant reduction in cockroach populations by the third visit in units that were prepared and had improved sanitation. The IPM peer educator is a low-cost model of educating and engaging residents of low-income, multi-family housing. It is also a potential source of professional training and jobs for public housing and other low-income housing residents.
Key Words German cockroach, public housing, IPM Educator

INTRODUCTION

German cockroach (*Blatella germanica*) is the most common pest of urban, multi-family low-income housing (Miller and Meek, 2004). Recent studies in Boston public housing conducted by the Healthy Public Housing Initiative (2000-2004), a community-city-university collaborative (Healthy Public Housing Initiative, 2005), have found a high rate of cockroach allergy among asthmatic children; a prevalence of asthma at three to four times the national average; high levels of German cockroach allergen in house dust; and pesticides being used by the majority of residents, including multiple legal, illegal and restricted pesticides, as determined by indoor dust samples and interviews (Levy et al., 2004; Hynes, et al., 2000; Brugge et al., 2001; Peters et al., 2005; Julien et al., 2005).

Cockroach allergen is implicated in asthma exacerbation and initiation, and, concomitantly, in the growing social and medical costs of the disease. Studies of inner city asthmatics allergic to cockroach antigen have found that exposure to high levels of cockroach allergen is associated with more severe asthma (Ramsey et al., 2005; Rosentreich et al., 1997). High cockroach allergen levels are also associated with asthma sensitization and initiation (Institute of Medicine, 2000). Children living in poverty and children insured by Medicaid are at higher risk of severe asthma exacerbation, asthma-related use of emergency room, and asthma hospitalization (Hopkin and Donahue, 2004). Pediatric asthma is the leading cause of school absence (Neukirch et al., 1999); and the leading cause of caretaker absenteeism from work (Ordonez, 1997). Household surveys and exposure studies in urban communities have found that chemical pesticides are commonly used (Brenner et al., 2003). Given the disproportionate burden of asthma on inner-city populations and the medical system; the predominant German cockroach infestation in urban, low-income housing; and residents' use of multiple high toxicity pesticides to combat pest infestation, models of pest control that are environmentally safe and effective and that educate, engage, and empower residents are urgently needed in public and other low-income, multi-family housing. The asthma epidemic in inner cities and its link to pest infestation and high pesticide use was the initial impetus for the Healthy Public Housing Initiative.

A second impetus for our collaborative work in Boston public housing arose from the social reality of risk and resilience in public housing. Many of Boston's poorest families live in public housing: The average household yearly income for BHA residents in 2003 was $11,250–17% of Boston's median household income. Thirty-eight percent of the 26,000 residents living in Boston public housing are children, a higher percentage than in the city as a whole. We know that children are particularly vulnerable to certain environmental exposures (Schettler et al., 2000) and that most early childhood injuries occur in the home (Gallagher et al., 1985). Boston public housing mirrors the gender and race trends for poverty in Boston and the United States (Boston persistent poverty project, 2001; Epstein, 1997). Seventy-two percent of households are headed by women (BHA Director of Planning, personal communication, June 5, 2001). The resident population is 31% black non-Hispanic, 22% white non-Hispanic, 35% Hispanic, 8% Asian, and 3% "other".

Numerous studies have documented high rates of morbidity and mortality among low-income minorities, the urban poor, and residents of poor quality public housing (Connecticut Department of Public Health, 1999; Polednak, 1998; Malmgren et al., 1996; Ambrose and Hill, 1996). Other studies have amassed evidence that income inequality, as well as relative poverty, result in decreased life expectancy and higher morbidity (Wilkinson, 1996). Income inequality in the U.S., as measured by the Gini coefficient for family income, rose 14% between 1973 and 1991 and did not decrease during the 1990s. From 2000 to 2003, the period of our work in Boston public housing, the number of poor and uninsured increased; and in 2003, income inequality grew, with those who are poorest, single women with children, experiencing the greatest increase in poverty (Leonhardt, 2004; Center on Budget and Policy Priorities, 2006). During the same period, public investment in education, job training, public housing, child care, basic infrastructure, environment, and energy fell to about one-half its levels of the 1960s and 1970s, when adjusted for the size of the economy (Miller, 2004). The BHA capital budget, that is, funding for housing improvement, was reduced by 23% between 2000 and 2003 (Boston Housing Authority, 2004).

Even with the burden of poverty and the deteriorating social conditions for the poor, public housing remains a prime locus for environmental health intervention for positive and strategic reasons. Housing developments elect 'tenant task forces' that wield some power in decisions concerning the development; such developments offer community programs for youth and adults and, in some cases, multi-service centers. Public housing is centrally administered and financed by a housing authority that is responsible for building maintenance and renovation. In Boston, housing developments are located within the catchments of a network of community health centers used by residents. Proximity to community health centers, management infrastructure, and resident leadership make public housing residents and the housing authority strong partners for collaboration with universities, local health centers, and non-profit organizations to achieve the following goals: improving the health of residents with better maintenance and repair of their housing; providing community health programs tailored to their lives and reality; and empowering residents through training, employment, and shared decision-making.

IPM EDUCATOR PROGRAM

The Healthy Public Housing Initiative (HPHI), in an effort to develop an effective integrated pest management (IPM) intervention research program in Boston public housing that was based on a community-city-university model of collaboration, devised an IPM Educator program in which residents were recruited, trained, and employed to work as peer educators on issues of sanitation and preparation for IPM with families of asthmatic children enrolled in the study. IPM is a systematic method of controlling pest populations by monitoring populations of pests, pest damage and environmental conditions; reducing pest populations to acceptable levels using strategies that may include a combination of cultural, behavioral and low-volatile chemical controls together with housing repair; and evaluating the effectiveness of treatments (IPM Definition, 2005). After the intervention research project was completed, the IPM Educator program was further refined in a pilot project in the Charlestown Housing Development of the Boston Housing Authority (BHA). This paper presents an analysis of data from the pilot project in order to assess the potential effectiveness of the IPM Educator model for IPM programs in public housing and other multi-family, low-income housing.

The Charlestown Housing Development (CHD) is one of the largest family developments of the Boston Housing Authority (BHA) with over 1,000 residential units. The BHA contracts with pest control management companies to treat the pest infestation common to many of the home units in the CHD. Over the years, this strategy to control pests in the CHD has had only limited success, even as the BHA has begun shifting from a traditional pest control program employing baseboard and crack and crevice treatment with spray and dust form pesticides to IPM. Some of the reasons cited for this limited success are infrequent and irregular resident preparation for the pest control visit; sanitation and clutter issues that prevent proper pesticide application; inconsistent notification of residents regarding scheduled extermination visits; and inadequate pest inspection, sanitation, treatment, and communication with residents on the part of the pest contractor (Interview with Jim McCarthy, BHA, 8 June 2005). This last factor suggests that pest contractors may not provide full home inspection, only treat commonly infested areas such as kitchens and bathrooms, and neglect communicating with residents about the role of sanitation in pest control. Poor maintenance of common areas in the housing development may also lead to increased pest access into the buildings, causing infested common areas and leading to infested living units.

IPM specialists have argued that comprehensive IPM in residential and commercial buildings must include building maintenance; education and participation of residents; rigorous sanitation with removal of food, water and harborage sources; as well as application of low-volatile chemicals when necessary (Seikel, 2004). Implementing successful IPM in multi-family, low-income urban housing, however, is particularly challenging when older buildings have serious structural problems and poor maintenance (Kinney et al., 2002).

There is a paucity of IPM studies in urban, multi-family, low-income settings; and results from these studies have been mixed (Miller and Meek, 2004; Brenner et al., 2003). Our paper compares IPM treatment in public housing with and without an IPM Educator, using a pre- and post-intervention pilot design. Residents served as their own controls, and, thus, confounding factors were reduced. To our knowledge, this is the first evaluation of IPM that examines the efficacy of peer IPM education on resident participation in pest control and cockroach reduction in public housing.

MATERIALS AND METHODS

The pilot study consisted of a community-based IPM education intervention in 34 moderate- to high-infested living units in the CHD. Moderate- to high-infested living units are units that were determined to have the heaviest cockroach infestation levels in the pilot study buildings by the pest control operator in a baseline assessment using sticky insect traps and monitors.

Study Intervention

The pilot project involved one trained resident IPM Educator and one pest control operator (PCO) employing IPM treatment, specifically application of gel baits. The IPM Educator received 20 hours of classroom and field-based instruction and skills development, with follow-up field supervision, using university, community and housing authority staff. The main role of the resident/peer IPM Educator was to educate the residents of pest infested units about why and how to properly prepare for IPM treatments by the PCO; how to prevent future infestations with good housekeeping methods, including regular removal of dead insects; removal of food, water, and harborage for pests; and clutter reduction; and how to submit work orders for repairs related to pest infestation, such as holes in walls, ceilings, and floors, and water leaks. Preparation for IPM treatment includes clearing out kitchen and bathroom wall and sink cabinets, and closets, if necessary, so that the PCO can see where access areas for pests may be and where pests are breeding, and reach and treat infested areas.

The project involved 3 visits by the PCO, a baseline visit and 2 additional visits approximately 2 to 4 weeks apart. A written list of specific IPM preparation activities that were to be completed was provided to the resident prior to each of three PCO visits. At the baseline visit, prior to the IPM education intervention, the PCO assessed the preparation, cleanliness, and pest activity level (from cockroach counts in traps placed two weeks prior to visit), and applied gel bait. These assessments were made by the PCO alone or with the IPM Educator, depending on scheduling and availability. After the baseline assessment and treatment visit by the PCO, the IPM Educator conducted the first education intervention with the residents. IPM education was again conducted by the IPM Educator prior to the second and third visits by the PCO in order to assist the residents, if necessary, in preparing for the PCO visit and to reinforce resident participation in IPM. Assessments of preparation, cleanliness, and pest activity level at the second and third visits were made by the IPM Educator prior to any efforts to assist the resident with preparation of the apartment.

Study Outcomes

The primary outcome of this study was the effectiveness of the IPM education intervention in increasing resident preparation for extermination. The PCO and the IPM Educator rated preparedness subjectively (Yes/No) at the baseline visit and at the two following visits (visit 2 and visit 3).

Secondary outcomes included assessment of the cleanliness of the unit at baseline compared to the final study visit, and change in pest activity level before and after the IPM education intervention. Cleanliness was measured by the PCO and IPM Educator at baseline visit 1, and at visits 2 and 3 on a rating scale from 0 to 5. The cleanliness rating was recorded immediately following visits 1, 2 and 3. The scaled rating of cleanliness data was reconciled by the development manager as 'good', 'fair', or 'poor'. Pest activity was measured as 'no activity', 'light activity', 'moderate activity', and 'heavy activity'. Pest activity was measured by counting the number of cockroaches on sticky trap monitors at the baseline visit and at the second and third IPM visits. Five monitors were placed in similar locations at each visit, and were collected and counted for activity level rating at the following visit. No cockroaches on a total of 5 traps indicated 'no activity', 1-10 cockroaches indicated 'light activity', 11-30 cockroaches indicated 'moderate activity', and more than 30 cockroaches indicated 'heavy activity'. Residents were also asked to self rate the level of pest activity prior to the study and following the study. A standardized form was used by the IPM Educator and the PCO to report information about the preparedness, sanitation, and cockroach activity at each home visit. The data was compiled, reviewed for completeness and concordance, and entered into an Excel spreadsheet by the development manager. Intervention effectiveness was measured by change in pest activity level from baseline visit 1 (prior to any education intervention procedures) to the final visit.

Data Analysis

This pilot project analysis uses a pre- and post- evaluation of study outcomes. Therefore, visit 1 data taken prior to the education intervention act as control data compared to data from visits 2 and 3. Preparedness prior to extermination was evaluated using McNemar's chi-square statistic test. McNemar's chi-square test applies to matched or paired data, and is appropriate for this study because the control time periods (baseline/visit 1) and the test time periods (visits 2 and 3) represent the same apartment, and are therefore matched or paired. Preparation (yes/no) was evaluated at baseline/visit one (pre-IPM education) and was compared to preparation rating (yes/no) at visit 2 and visit 3 (post-IPM Education). The Wilcoxon Signed Rank Test was used to evaluate several of the secondary outcomes in this study, including cleanliness and pest activity. A chi square test of frequency was used to compare the cleanliness and preparedness of units that had either no or light pest activity at visit 3, and a paired t-test was used to analyze data regarding the resident rating of pest activity level. SAS Proprietary Software 8.2 was used to analyze all data.

RESULTS

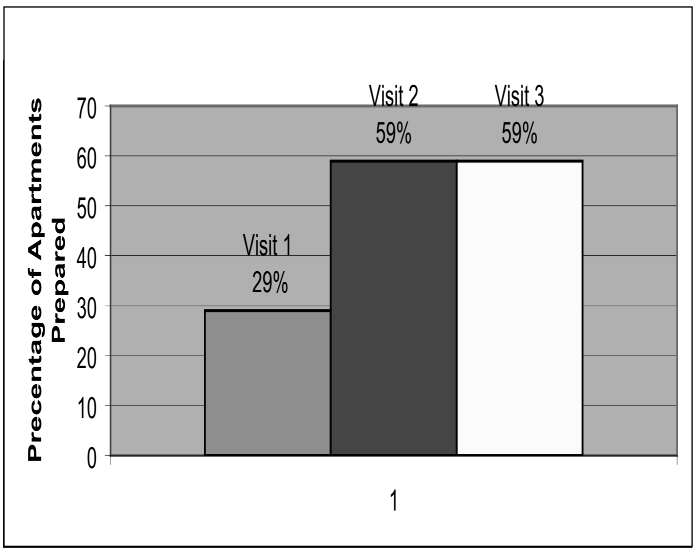
The primary outcome of this study was whether or not participants were more likely to prepare for an IPM treatment following an education intervention. Twenty-nine percent of subjects ($n = 10$) were prepared for baseline visit 1, and 59% of subjects ($n = 20$) were prepared for visit 2 and visit 3 each, following the visits by the resident IPM Educator ($p=0.0016$) (Figure 1). Ten additional units were prepared for visit 2 and visit 3 than were prepared at visit 1. There was no difference in the number and identity of units that were prepared at visit 2 and visit 3.

The level of pest activity was measured at baseline visit 1, visit 2, and visit 3; and, due to eligibility criteria, all units had either high or moderate pest activity prior to study entry (Figure 2). Comparisons were made between visit 1 and visit 2 and between visit 1 and visit 3. Only one unit had lighter pest activity from visit 1 to visit 2. There was no difference in the median values of pest activity level at visit 1 compared to visit 2 ($p=1.00$). However, the pest activity level at visit 3 was significantly lower than pest activity at visit 1 ($p \leq 0.0001$), with 50% of the units (n = 17) rated as having light or no activity after visit 3. Cleanliness also had significantly improved after education at both visit 2 ($p \leq 0.0039$) and at visit 3 ($p \leq 0.001$). At baseline visit 1, only six units were rated as "good" in cleanliness (17.6%). After education, at visit 2, six additional units were rated as clean (35.2%). At visit 3, 15 units were rated as "good" in cleanliness (44.1%).

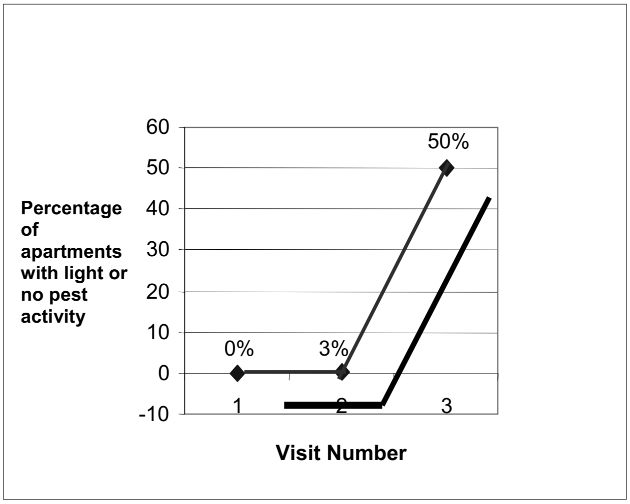
We also compared levels of pest activity by whether or not the units were prepared or clean at visit 3 (Figure 3). At visit 3, 20 out of 34 units were prepared for the extermination visit. Of all units that were prepared, 80% had no or light pest activity versus 7% of units that were unprepared ($p<0.0001$). Compared to units that were unprepared for the extermination visit, units that were prepared for the extermination visit were 11.2 times as likely to have light or no pest activity at visit 3 (95% CI: 1.7 to 75). At visit 3, 15 of 34 housing units were rated as "good" cleanliness. One hundred percent (100%) of the clean apartments had light or no pest activity at visit 3 versus 10.5% that were not clean ($p<0.0001$). Compared to units that were either rated as "fair" or "poor" cleanliness, units that were clean were 9.5 times as likely to have light or no pest activity at visit 3 (95% CI: 2.6 to 35.2). It is noteworthy that 100% of units that were both clean and prepared (n=14) had no or light activity at visit 3, while 100% of units that were both not prepared and not clean (n=7) had moderate or heavy pest activity at visit 3.

Twenty-one residents agreed to rate, on a scale from 1 to 10, the level of infestation prior to participating in the program and after participating in the program. Data were analyzed using a paired t-test. The mean difference of resident rating of pest activity level is 5.76, which indicates an overall decrease in resident observed pest activity at visit 3 ($p<0.001$). In fact, every resident who responded indicated that there was improvement in pest activity from visit 1 to visit 3. We were not able to correlate the resident response with pest activity as measured by the pest monitors because the satisfaction evaluation was done anonymously; however, earlier studies in public housing have shown good correlation between resident assessment of cockroach activity and cockroach presence as measured by cockroach allergen (Welker-Hood et al., 2005).

Percentages of apartments prepared before and after intervention. Visit 1 represents the percentage of apartments that were prepared prior to the intervention.



Percentages of all apartments with light or no pest activity at each visit. Visit 1 represents the baseline visit. No apartments had light or no pest activity at baseline as a requirement of study entry.



DISCUSSION

The immediate program goal of the IPM pilot program at the CHD was to educate residents regarding pest biology and habits, best practices to prevent pest infestation, and practices that help the extermination process to be more effective, employing a resident of the housing development as the primary peer educator. Because this was a pilot project, the primary analysis goal was to test a community-based model of IPM for implementation in public housing and multi-family subsidized housing, using empirical results. We also wanted to evaluate the effectiveness of the IPM Educator program, both for the peer educator and also for engaging residents as partners in integrated pest management, in order to identify areas for improvement that could make the program more effective in future demonstration and implementation programs. These data provide preliminary evidence that IPM programs that include resident IPM education may be helpful in reducing or eliminating pest activity in public housing developments. The data do show a significant difference in the number of residents that were considered prepared after receiving education on the methods and importance of preparation for extermination, and suggest that there is a benefit of improved cleanliness in the units after receiving education from a peer IPM Educator. Overall, there was a significant reduction in the activity level of pests in the prepared and cleaned units at visit 3, and the resident observed pest activity from baseline visit 1 to visit 3.

Due to the small sample size, statistical power to detect associations that are truly present may be limited. We were not able, for example, to clearly identify whether preparation for extermination and cleanliness level in the unit independently contribute to either light or no activity at visit 3, given our finding that 100% of units that were prepared and clean had either no or light pest activity, while 100% of units that were both unprepared and not clean had moderate or heavy pest activity. It is important to note that all units were prepared for the extermination visits at visit 2 and visit 3 because the IPM Educator arrived prior to the IPM contractor in order to assist the resident with preparation. Ratings for preparation were made by the IPM Educator prior to assisting the resident with any preparation. This may indicate that cleanliness is a more important predictor of pest activity level. Future studies and demonstration projects that involve more households may be able to differentiate between the benefits of preparation for IPM treatment and maintaining a clean home to eliminate food, water and harborage sources for pests.

As with any study, it is possible that bias and confounding have affected results. It is possible that there is bias in the collection of information. Specifically, because the IPM Educator is collecting data on the potential benefits of his/her own education causes concern for overestimation of preparation and cleanliness, variables that have the potential for subjective analysis. Since the PCO collected the same information and both sets were compiled and reviewed for concordance by the development manager, the risk of subjective bias was diminished. Information collection bias on pest activity level is less concerning because data are collected by counting the number of pests on traps and are less subjective.

Confounding is also a possibility in this study. Many confounders may be eliminated because the control group is the same as the intervention group; however, it is possible that other factors not studied could explain the increase in preparation and cleanliness and decrease in pest activity level in housing units after receiving intervention education. It is possible that receiving pesticide treatment alone may explain the decrease in pest activity levels; however previous extermination efforts in the CHD have been unproductive in preventing and controlling pest activity, and there is a clear benefit at visit 3 in units that maintained a clean apartment and that were rated prepared for the extermination visit. Furthermore, situations of chronic, recurring cockroach activity in low income housing, multi-housing indicate that IPM treatment alone, without sanitation and preparation, is not successful in eliminating infestations (HPHI, 2004). Future studies may include randomization of units to receive education intervention plus extermination or extermination alone to decrease potential for confounders.

RECOMMENDATIONS

IPM Educator Program

The results of this pilot project are important for the goal of establishing a pest control program that is effective, environmentally safe and reliable in a public housing setting; and efforts to continue evaluation research in this area should be supported. Reduction and control of pests in public housing is extremely difficult to achieve without involving building management and residents as partners in the process. Simply exchanging IPM treatment in place of more traditional routine spraying does not result in successful reduction of pests (HPHI, 2004). Our IPM pilot program indicates that when residents are peer-educated to be partners in IPM, through understanding pest habits, sanitation, and preparation for the IPM treatment, that IPM can be effective in reducing infestation and, potentially, associated allergen burden and pesticide use. Future IPM projects in public and low-income housing can include demonstration projects to further improve and solidify both the IPM Educator role and also the model of partnership among resident, peer educator, IPM contractor, and development manager that is needed for a successful program. Comprehensive evaluation of IPM demonstrations would include change in pest activity, as well as change in cockroach allergen in house dust and change in resident pesticide use in order to document the full health and environment benefits of a comprehensive IPM program. Cost-benefit analyses that include the full costs and benefits of this program, including the cost of the IPM Educator and the long-term benefits such as fewer PCO extermination visits, need to be conducted. Health policy analysts are also interested in evaluating the health benefits and medical savings for asthmatics in reduced exposure to allergens as a result of successful IPM.

More effort needs to be given to understanding and addressing the obstacles for residents to prepare and clean for IPM treatment and to the totality of contractual job requirements for the IPM contractor, including monitoring, removal of old gel bait and HEPA vacuuming where warranted, minor caulking and repair, as well as gel application. Trainings for multi-family property managers and public housing authorities, including their PCOs and potential resident IPM Educators, in the elements of a comprehensive IPM program, as described in this paper, are a promising, low-cost way to disseminate this model of environmentally sound pest control in low-income, multi-family housing (Toxics Use Reduction Institute Grant Program, 2005).

ENVIRONMENTAL JUSTICE

Housing is people's most intimate local environment; and collaborative efforts, such as this one, together with campaigns for safe, secure, and affordable housing are issues of environmental justice that are as significant and meaningful as campaigns for clean ambient air, water and soil. In this community-city-university project, we were committed both to creating a cleaner, more healthful, more dignified and just indoor environment and to building the knowledge, skills and abilities of residents in the process.

We recommend a model of community-university-local government collaboration whereby community partners are offered the opportunity of equal involvement that includes training, employment with just compensation, and a continual learning environment. In evaluation interviews with resident IPM Educators and residents assisted by peer IPM Educators, which we conducted in this IPM Educator pilot project and throughout the course of our larger Healthy Public Housing Initiative project, residents reported how vital the new knowledge and skills were for their lives. They cited job readiness, a greater sense of control over their own living environment, confidence in public speaking and advocacy, greater skill in reading, and knowledge acquired about asthma and environmental triggers as the benefits gained in being trained and employed in our project (Report to W.K. Kellogg Foundation). Collaborations among communities, government agencies, and universities to improve public health and the local environment–be they research, intervention, or services–have potential and ought to seek to achieve environmental protection, health promotion, and social justice together. This is a core precept and ideal of community-based research and environmental justice.

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