Effect of a Home Intervention Program on Pediatric Asthma in an Environmental Justice Community

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Asthma prevalence rates are at an all-time high in the United States with over 25 million persons diagnosed with asthma. African Americans and other minorities have higher asthma prevalence and higher exposure to environmental factors that worsen asthma as compared to Caucasians. This article describes the evaluation of an inner-city home-based asthma education and environmental remediation program that addressed both indoor and outdoor triggers through collaboration between a health system and local environmental justice organization. The program enrolled 132 children older than 2.5 years and centers on a 4- to 6-week intervention with peer counselors using the U.S. Environmental Protection Agency Asthma Home Environment Checklist *and the* You Can Control Asthma *curriculum. Families receive asthma-friendly environmental home kits. Peer counselors reinforce key asthma management messages and facilitate the completion of Asthma Action Plans. The environmental justice community partner organized block cleanups to reduce outdoor triggers. The evaluation used a pretest–posttest design to assess changes in client behavior and asthma symptoms. Data were collected at baseline and during a 6-month postintervention period. Participants saw enhanced conditions on asthma severity and control. The improvement was greatest for children whose asthma was considered "severe" based on the validated Asthma Control Test. Other positive results include the following: greater completion of Asthma Action Plans, significant reduction in the number of emergency room visits (*p *= .006), and substantial decreases in school absenteeism (*p *= .008) and use of rescue medications (*p *= .049). The evaluation suggests that the program was effective in improving asthma self-management in a high-risk population living within an environmental justice community.*

Keywords: *behavior change; child/adolescent health; asthma; chronic disease; community intervention; environmental health; health disparities; health education; lay health advisors/community health workers; Black/African American; minority health; evaluation design; program planning and evaluation*

Asthma is a chronic airway disorder characterized by inflammation, mucous production, and bronchoconstriction. Asthma prevalence rates in the United States increased from 7.3% (2001) to 8.4% (2010) affecting over 25 million persons (Moorman et al., 2012). From 2008 to 2010, prevalence was higher among children ages 0 to 17 than adults; among multiple-race, Black, and Native Americans/Alaskans than Whites; and among low-income and/or urban populations (Moorman et al., 2012).

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The growing prevalence of asthma poses serious health and economic threats. In 2009, the average yearly cost of care for an asthmatic child was over $1,000 (Centers for Disease Control and Prevention [CDC], 2012), and almost 50% of children miss at least 1 school day due to asthma. Shendell et al. (2010) noted that asthma is the primary cause for chronic illness absenteeism but observed that limited estimated national data exist. They suggested there is currently no accurate way to measure potential disparities in disease-related school absenteeism. Mizan, Shendell, and Rhoads (2011) suggested that asthma is associated with increased 1-day absences from school but is not associated with longer absences. Impoverished and minority populations are more likely to experience cost of control medicines as a barrier, be hospitalized, or visit emergency rooms (ERs) than White counterparts (CDC, 2012). Lack of access to quality medical care and higher exposure to environmental factors often worsen asthma among disadvantaged populations.

While there are no cures for asthma, management can help individuals control symptoms. Asthma management includes medical therapies and allergen avoidance (National Asthma Education and Prevention Program [NAEPP], 2007). When symptoms are reduced, and quick-relief bronchodilators are used less, asthma control is improved. Several studies (NAEPP, 2007) have shown that allergen avoidance and environmental mitigation can reduce hospitalization and ER visits. The NAEPP (2008) recommends that disparate groups receive culturally competent clinical asthma management and patient education, and recommends community-based interventions to include education and remediation of pollutants in the indoor environment and outdoor air.

In 2008, the CDC recognized the documented effectiveness of home-based multitrigger, multicomponent interventions for asthma control in children. Townsend and George's (2011) literature review noted that multiple-trigger environmental remediation programs are more effective than single-trigger programs in reducing asthma morbidity as measured by reduction in acute asthma provider visits, missed school days, decreased symptoms, and reduced allergen exposure with improved lung function. Many programs used lay educators. The effectiveness of lay educators is explained by the social cognitive (learning) theory, which incorporates the interrelationship between self-regulation and environment. This theory includes observational learning and vicarious reinforcement. Lay educators as key influencers within the social environment demonstrate trigger reduction techniques (observational) and share the effectiveness of their experiences (vicarious reinforcement). Families practice these techniques and directly experience their effectiveness, which further reinforces behavior changes. Lay educators use social contracting with goal setting, rewards, and monitoring, factors within this theoretical model.

In 1999, in response to growing asthma prevalence rates, an inner-city health system began a school-based asthma program providing services that include the following: asthma screening, spirometry referral, and education for students, parents, and staff. In 2010, the program partnered with an environmental justice community organization to implement an indoor/outdoor environmental remediation and education program using peer educators.

This article describes the evaluation of the program and its impact on asthma control for inner-city children residing in an environmental justice community and falls within the category of applied research. The evaluation suggested the intervention had a positive impact on children's health, particularly for those children who had severe asthma.

METHOD

The Program

The program was designed as an evidence-based intervention using previous studies (e.g., Bryant-Stephens, Kurian, Guo, & Zhao, 2009; Celano et al., 2012; Laster, Holsey, Shendell, McCarty, & Celano, 2009) as models. The Bryant-Stephens et al. (2009) protocol was modified for this program to accommodate less funding and a shorter grant period. The program conducted four (instead of five) home visits that incorporated lesson plans based on the validated *You Can Control Asthma* (Asthma and Allergy Foundation, 2005) curriculum. Postintervention follow-up for the program was for 6 months (instead of 12 months), using new data collection tools. For example, Bryant-Stephens et al. (2009) used a knowledge quiz and symptom diaries, but this program used the Asthma Control Test (ACT) and the U.S. Environmental Protection Agency (EPA; 2004) *Asthma Home Environment Checklist*. Few home visiting programs have used the EPA checklist to conduct home assessments (other than the *Request for Application Announcement 2014 School Nurse Mini-Grants* by the Montana Asthma Control Program, Chronic Disease & Health Promotion Bureau, n.d.).

The partnership between the inner-city health system and the environmental justice community organization is supported in the literature, most notably by Clark (2012), who notes that community-based programs enable low-income, minority families to build

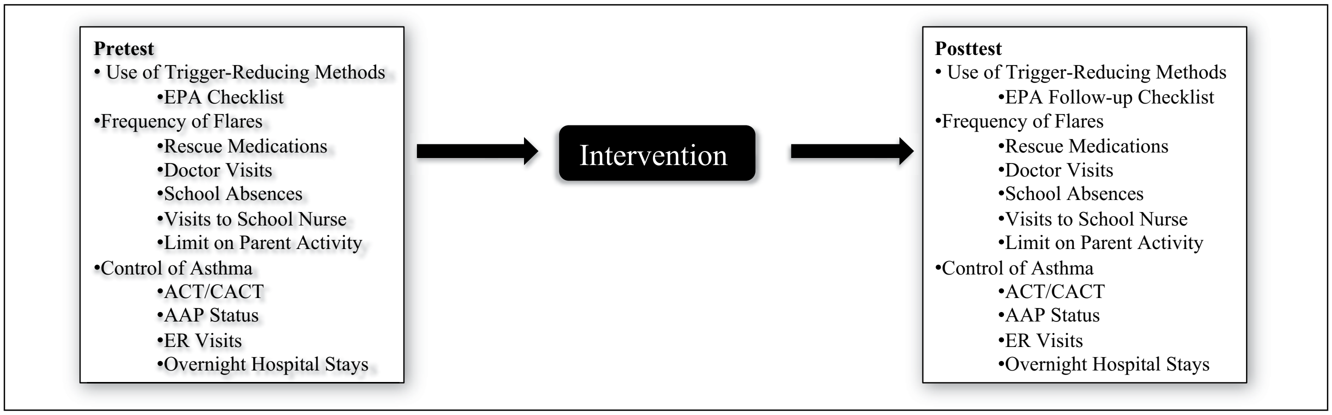

FIGURE 1 Basic Theoretical Model
NOTE: EPA = Environmental Protection Agency; ACT = Asthma Control Test; CACT = Child Asthma Control Test; AAP = Asthma Action Plan; ER = emergency room. This flowchart outlines the basic setup of the study. The two white boxes list the target asthma conditions of the study and the data used to measure those conditions.

capacity to overcome many of the financial, social, and political barriers to managing asthma. Such partnerships can tailor asthma management interventions more specifically to the community needs. Hoppin, Jacobs, and Ribble (2006) find that partnerships are required for effective planning and implementation of home environmental interventions.

The program centers on a 4- to 6-week intervention, which includes four visits in which peer educators use standard lesson plans. Lessons were based on the EPA checklist, other EPA literature, and the *You Can Control Asthma* curriculum. Peers instruct families about ways to reduce indoor asthma triggers. The families receive asthma-friendly environmental home kits that contain allergen-proof mattress/pillow encasings, nontoxic cleaning supplies, storage bins and baits for pests. The peer educators teach integrative pest management as components of environmental remediation and reinforce key messages around the proper use of asthma medicines and devices such as spacers. Peer educators discuss the importance of having Asthma Action Plans (AAPs) and distribute forms to parents for completion in partnership with their children's primary care provider.

The environmental justice partner organized block cleanups to reduce outdoor triggers and help residents reduce clutter that harbors triggers like rodents. The peer educators suggested blocks for the cleanups based on client concerns about their neighborhoods.

Prior to the intervention, a master's-level health educator serving as program manager and a peer educator cofacilitate a client intake visit. During the intake visit, baseline data are collected, including the validated ACT (Schatz et al., 2006) or for children younger than 12 years the Child Asthma Control Test (CACT; Liu et al., 2007).

Following the education program, the program manager engages in a 6-month follow-up period that entails a 2-week follow-up phone survey, a 3-month follow-up phone survey, and a final 6-month follow-up home visit during which families complete a final survey and other data collection tools.

Sample Participation

The program recruited families with asthmatic children age 2 to 17 years through community events, outreach to families identified from monthly ER listings, and referrals from school nurses, physicians, and other providers. The staff outreached to 382 families using telephone calls, with 53% of these families never being reached due to wrong or disconnected numbers or never having returned calls after leaving four messages. Of the 179 families reached, 69 (39%) families consisting of 132 children were enrolled in the program over 2.5 years. However, 12 of the 69 families (17%) were dropped before completion of the 4-visit intervention and another 16 families had incomplete follow-up surveys. Therefore, the sample data presented in this article consist of 41 of the 179 families reached, with 80 children.

Evaluation Design

A pretest–posttest design was followed (see Figure 1) to evaluate the changes in client behavior and asthma symptoms from the intervention using the data collected both prior to and after the intervention. The pretest data act as control units for each family and child, allowing examination of results in the context of the individual's or household's initial status. The evaluation focused on two key questions:

1. Did the program affect the use of trigger-reducing methods in the home, frequency of asthma exacerbations, and level of asthma control?
2. Were the program effects different for different groups?

Figure 1 lists variables used to measure the use of trigger-reducing methods, frequency of flares, and level of asthma control.

The data can be classified into three groups: (a) demographic, descriptive data (e.g., income, ethnicity), (b) pretest data on the measures listed in Figure 1, and (c) posttest data on the measures shown in Figure 1. In addition, evaluators constructed two variables for use in the analysis: number of changes in the home and whether or not a family completed the program on time (a 6-week intervention with a 6-month follow-up). The number of changes in the home is one measure of how much a family was able or influenced to respond to make changes in the home to help reduce prevalence and severity of asthma symptoms. Comparing the initial and final sets of data collected using the EPA checklist and using the postintervention surveys as guides, evaluators tallied the number of changes a family made to reduce home triggers (e.g., use nontoxic cleaners, get rid of a pet). All but one family implemented at least the two changes of using the bins and supply kit provided by the program. Researchers classified families who made only one additional change beyond what the program provided as having a "low number of changes." If a family made four or more changes, they made at least two changes in addition to using the materials provided by the program and were thus classified as having a "high number of changes." Evaluators used the variable completed on time as a proxy for the barriers families may encounter in following through with suggestions made throughout the intervention. To determine whether or not a family was engaged within the protocol's time frame, evaluators counted the number of days between the initial visit and the 6-month follow-up visit. Any family that finished more than 4 weeks beyond the 225 days allotted for the 6 weeks of intervention and the 6 months of follow-up was considered outside the protocol period.

Statistical Analyses

Evaluators used two methods to investigate the overall effect of the program: matched-pairs t tests and binomial tests. Evaluators examined each of the variables, except for AAP status in Figure 1, using the matched-pairs test.

The collected data on AAPs are unique. Unlike other data in the set, some of the participants had implemented the AAP prior to intake. For the purposes of our evaluation, if a child was noted to have an AAP at intake, it was assumed that the child had received the AAP, completed it with the doctor, and shared it with the school nurse. Evaluators compared the percentage of children who have completed and shared an AAP prior to the intervention to the percentage of children who have completed and shared the AAP at the end of the program, using a binomial test. To examine the differing effects of the program, evaluators used two-sample t tests to determine whether or not changes between the pretest and posttest measurements of the variables listed in Figure 1 were different across numerous groups, including on time and behind schedule, high number of changes and low number of changes, gender, parent employment status, and others.

RESULTS AND DISCUSSION

The sample of 80 children is from 41 families. Twenty-two of these families (54%) had only 1 asthmatic child, whereas 19 (46%) families had multiple asthmatic children (range 2-6, with an average of 2.61). The average child's age was 7 years during the program and their average age at time of diagnosis was 2 years old. Most children identified as African American and 54% were male. The average parent was 35 years old. Eighteen percent of parents had less than high school education and 44% were high school graduates. Another 38% had some post–high school education, yet 51% of parents were unemployed. A significant number of families were low income; 11% had annual incomes less than $10,000 and 24% had incomes between $10,000 and $19,000. Most of the families were renters, with 77% living in row or twin houses and 23% in apartments, and 44% had smokers in the home.

Two of the primary goals of the intervention were to reduce frequency of asthma exacerbations and improve asthma control. The results shown in Table 1 showed statistically significant improvement for both of these goals.

Participants saw enhanced conditions when it came to severity and control of asthma. For both children older and younger than 12 years, there was a slightly significant improvement in pre and posttest asthma control scores (CACT $p = .076$, ACT $p = .063$)

TABLE 1
Matched-Pairs *t* Tests

	N	*Difference*	SE	p
CACT score	53	0.943	0.522	.076†
Severe CACT score (pre-CACT < 20)	20	3.45	0.81	.0004***
ACT score	16	2.313	1.154	.063†
Severe ACT score (pre-ACT < 20)	9	4.222	1.832	.05*
Trips to ER	80	–0.513	0.181	.006**
Overnight hospital stay	80	–0.175	0.118	.141
Days missed of school	75	–4.733	1.731	.008**
Visits to doctor	80	–0.113	0.159	.482
Use of rescue medicines	80	–1.00	0.499	.049*

NOTE: ACT = Asthma Control Test; CACT = Child Asthma Control Test; ER = emergency room.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$, two-tailed test.

in addition to a decrease in visits to the ER (p = .006). The resulting change in asthma control score was on average a 2.3 point increase out of 25 points for children 12 and over.

The improvement was greater for children whose asthma was initially considered "severe" based on the standard for ACT/CACT score (Figure 2. For the children who began with a CACT or ACT score of less than 20, there was significant improvement from pretest to posttest (CACT $p < .001$, ACT $p = .050$) and a mean difference of 3 and 4 points, respectively. This substantial improvement for these children suggests that the intervention in an environmental justice community, though helpful to all children, was especially beneficial for children who initially had less control over their asthma.

The families that participated in the program were more likely to complete and share the AAP. Of the 58 children who needed an AAP, 22 completed the AAP with the doctor at some point during the program. The binomial test, comparing the percentage of children who initially had the AAP and those who had it by the end was statistically significant ($p < .001$). There was also a significant increase in the percentage of children who shared the AAP with their school nurse ($p < .001$).

There was a statistically significant reduction in the number of ER visits over a 90-day period (p = .006). Though there was no statistically significant improvement in the number of overnight hospital stays over a 90-day period (p = .141), there was an average decrease in the number of night stays.

There were statistically significant decreases in the number of school days missed (p = .008) and the frequency of the use of rescue medications per 14-day period (p = .049). On average, a child missed approximately 5 more days of school per 6 months before the intervention than after. Although there was no evidence of a difference in the number of doctor visits over a 6-month period (p = .482), families who are proactive in improving asthma conditions, such as the families who enrolled themselves in the program, are likely more diligent in keeping up with regular appointments and checkups with the doctor.

Table 2 shows the results of the two-sample *t* tests comparing different groups of children's experience in the program. There was no evidence to indicate that the parent's employment status played a role in the intervention's effectiveness.

Surprisingly, the number of changes made in the home also had no general effect on the conditions of asthma. Evaluators expected a child's asthma would improve as the number of changes a family made increased. There are no statistically significant two-sample *t* test between the children grouped by high number of changes (four or more) and low number of changes (three or less). This lack of effect might be attributed to the way the variable was calculated: There is no way to account for whether a change is major or minor. Some families made drastic changes that used a large amount of time and resources, for example, getting rid of pets, removing carpets, or moving entirely. Other families only made minor changes, for example, using the bins and supplies provided by the peer counselors. The variable "number of changes" only account for the number of changes made in the home, and does not indicate if changes were major or minor.

Evaluators were also curious about how the program implementation affected change in asthma conditions. They expected to see evidence that the improvement was greater for the families who finished the program within the planned time frame. Improvements in ACT scores were greater for those who finished the program on time (p = .024). It is possible the kinds of barriers that prevented a family from finishing within the time frame also prevented them from improving asthma conditions. The difference was also statistically significant for children who initially had severe asthma according to scores on the ACT (p = .016) and CACT (p = .13).

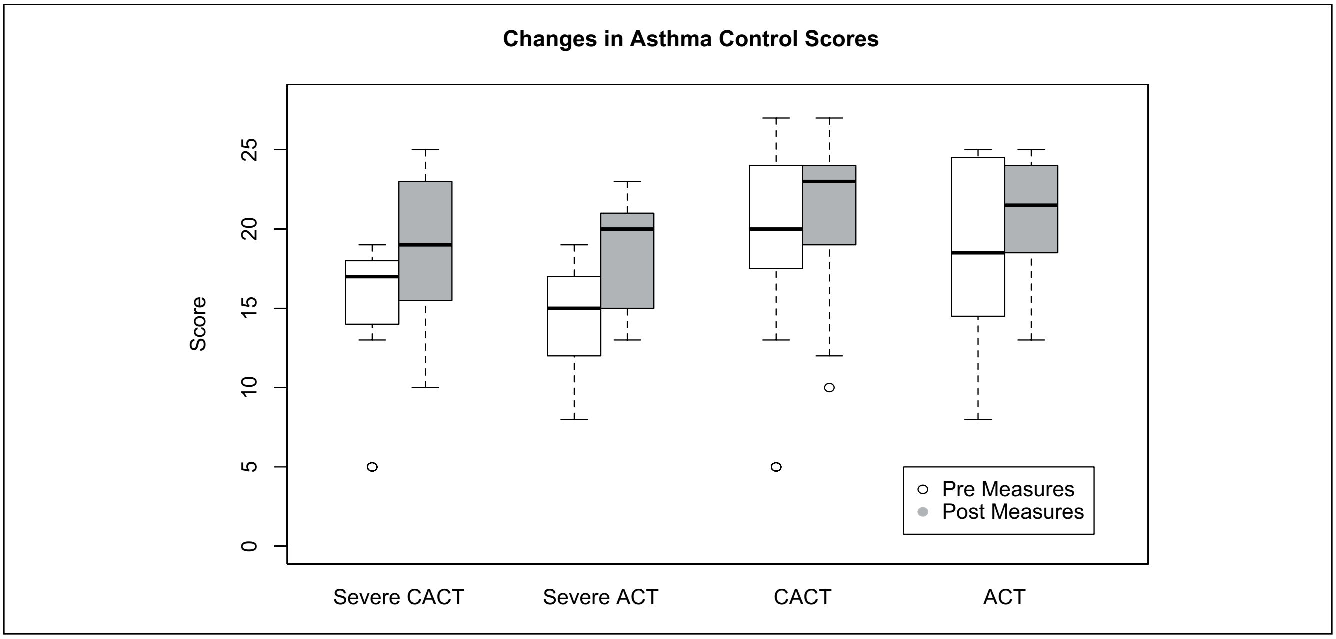

FIGURE 2 Pre- and Postintervention Measures in Reported Asthma Control Score
NOTE: ACT = Asthma Control Test; CACT = Child Asthma Control Test. See Figure 1 for tests/variables.

TABLE 2
Two-Sample *t* tests of Four Different Groups

		Employment		*High Changes*		*On Time*		*AAP KAMP*	
	N	*Difference*	p	*Difference*	p	*Difference*	p	*Difference*	p
CACT score	53	1.26 (1.04)	.234	0.46 (1.12)	.686	−0.05 (1.09)	.965	0.11 (1.03)	.852
Severe CACT (pre–CACT < 20)	20	0.82 (1.62)	.619	−1.50 (1.67)	.390	2.33 (1.46)	.129	0.06 (2.89)	.984
ACT score	16	1.91 (1.96)	.348	−0.58 (3.61)	.880	5.38 (1.91)	.024**	−2.49 (1.98)	.229
Severe ACT (pre–ACT < 20)	9	−0.93 (2.8)	.752	−2.93 (6.76)	.731	7.33 (2.20)	.016**	−4.83 (3.16)	.174
Trips to ER	80	0.37 (2.7)	.892	0.30 (0.42)	.477	0.07 (0.34)	.831	−0.23 (0.31)	.457
Overnight hospital stay	80	0.01 (9.16)	.971	0.33 (0.27)	.218	0.15 (0.26)	.570	0.49 (0.32)	.128
Days missed of school	75	4.20 (3.57)	.247	−3.06 (2.86)	.290	2.61 (3.21)	.419	5.16 (2.51)	.044**
Visits to doctor	80	0.27 (0.32)	.408	0.53 (2.39)	.827	0.36 (0.33)	.367	0.03 (0.40)	.941
Use of rescue medicines	80	0.40 (1.02)	.695	0.27 (0.98)	.787	−0.21 (1.04)	.844	−0.82 (1.00)	.417

NOTE: AAP = Asthma Action Plan; ACT = Asthma Control Test; CACT = Child Asthma Control Test; ER = emergency room. Standard errors are in parentheses. "Employment" refers to the parent's job status, "High Changes" refers to whether or not the family made 4+ changes in the home, "On Time" refers to the groups of children who finished on schedule and those who did not, and "AAP KAMP" refers to the groups of children who received an AAP during the program and those who did not.
**$p < .05$, two-tailed test.

Finally, evaluators examined if the change in AAP status affected other measures of asthma control and severity. Children who completed the AAP because of the program had fewer days absent from school (p = .044). The number of overnight hospital stays (p = .128), while lower, was not statistically significant for children who completed the AAP because of the program.

Limitations of the Evaluation

Several limitations were present in the evaluation. Client retention was a problem due to a high incidence of disconnected telephones, clients not being home for scheduled visits, and some moving out of the area. Thus, although 132 children from 69 families were enrolled in the program, the sample includes only 80 children from 41 families. However, only 17% of the 69 families were dropped before completing the intervention whereas others were dropped during postintervention. Given the low-income, at-risk population, the retention rate was much higher than expected. For example, a home visiting program for low-income African American families for pediatric asthma reports a 29% dropout rate (Brown et al., 2005).

The evaluation design lacked a control group. The environmental justice community partners argued against a randomized control design because some of the people recruited would not take part in the intervention. An alternative for future studies is a single-case study design evaluation (Cooper, Heron, Heward, 2007), which uses multiple measures of the same variable for each subject. This design takes into account the natural change that might be inherent in an evaluation such as this but allows all those recruited to participate in the intervention. Other similar programs have used a randomized crossover design (Bryant-Stephens et al., 2009).

All of the participants self-selected into the program—this is not a random sample. Parents who are proactive enough to enroll their children in a prevention program would be actively working to improve asthma conditions in other ways as well. There is no way to separate the confounding effects of the program and the proactivity of the parents. Future interventions within environmental justice communities could include a randomized control trial in which an enhanced component of the program is evaluated. Both the treatment and control groups would receive the current evidence-based intervention, but the treatment group would additionally receive an enhanced component. In cases where a randomized control trial is not possible, a case-crossover design could account for some of the self-selection bias that might exist.

For some analyses, specifically those involving the subset of children with initially severe asthma, there are small sample sizes. Though evaluators checked the statistical assumptions, future evaluations with larger sample sizes would be able to provide further evidence of the differences and means.

Additionally, this evaluation did not measure cost-effectiveness. The CDC (2011) reported total costs associated with management and treatment of asthma in the U.S. grew from nearly $53 billion in 2002 to about $56 billion in 2007. These costs include medical costs, lost school days and workdays, and early deaths. Future evaluations might observe the effects of asthma on costs and expenses for hospitals, insurance companies, and families in the program. It can be assumed that the positive impacts of the program have decreased medical costs, particularly for the families of children with severe asthma. Quality of life has improved as evidenced by reduced school absenteeism, which is associated with school performance and parent ability to work.

CONCLUSIONS

Overall, the program had a positive impact on childhood asthma among participants. Results suggest that the program improved ACT and CACT scores, reduced ER visits and school absenteeism, decreased the need to use rescue medications, and increased the percentage of distributed and shared AAPs. Results are similar to those found in other home-based, multitrigger, multicomponent interventions. Crocker et al. (2011) found reduced symptoms, school absenteeism, and acute care visits. Bryant-Stephens et al. (2009) found reduced ER and inpatient visits and nighttime wheezing. The program was especially effective for participants who began with severe asthma symptoms. The program affected different subgroups in different ways. In particular, evaluators noted that whether or not a family finished on time and had an AAP prior to the program affected a child's results in the program. Interestingly, neither a parent's employment status nor the number of changes in the home affected the outcomes.

A program such as this, combined with a community partnership already focused on addressing environmental injustices including outdoor and indoor pollutants known to be environmental triggers, may prove to be a cost-effective way to positively influence the health of children with asthma and can be a potential model for other such communities to reduce asthma burden on children. It is recommended that third-party payers reimburse in-home asthma education and environmental remediation visits by lay educators and that this become part of standard quality care for asthma management. This is keeping with updated regulations for preventive services under Medicaid and Children's Health Insurance Program and is important for sustainability of these interventions.

REFERENCES

Asthma and Allergy Foundation. (2005). *You can control asthma* (3rd rev.) [Asthma education program booklets]. Landover, MD: Author.

Brown, J., Demi, A., Celano, M., Bakeman, R., Kobrynski, L., & Wilson, S. R. (2005). A home visiting asthma education program: Challenges to program implementation. *Health Education & Behavior*, *32*, 42-56.

Bryant-Stephens, T., Kurian, C., Guo, R., & Zhao, H. (2009). Impact of a household environmental intervention delivered by lay health workers on asthma symptom control in urban, disadvantaged children with asthma. *American Journal of Public Health, 99*(Suppl. 3), S657-S665.

Celano, M. P., Holsey, C. N., Kobrynski, L. J. (2012). Home-based family intervention for low-income children with asthma: A randomized controlled pilot study. *Journal of Family Psychology*, *26*(2), 171-178.

Centers for Disease Control and Prevention. (2011). Vital signs: Asthma prevalence, disease characteristics, and self-management education—United States, 2001-2009. *Morbidity and Mortality Weekly Report*, *60*, 547-552.

Centers for Disease Control and Prevention. (2012). *Asthma's impact on the nation: Data from the CDC National Asthma Control Program*. Washington, DC: National Center for Health Statistics.

Clark, N. M. (2012). Community-based approaches to controlling childhood asthma. *Annual Review of Public Health*, *33*, 193-208.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Crocker, D., Kinyota, S., Dumitru, G., Ligon, C. B., Herman, E. J., Ferdinands, J. M., . . . Sipe, T. A. (2011). Effectiveness of home-based, multi-trigger, multicomponent interventions with an environmental focus for reducing asthma morbidity: A community guide systematic review. *American Journal of Preventive Medicine, 41*(2 Suppl. 1), S5-S32.

Environmental Protection Agency. (2004). *Asthma home environment checklist* (Publication No. EPA402-F-03-030). Washington, DC: Author.

Hoppin, P., Jacobs, M., & Ribble, M. (2006). *Enhancing asthma management using in-home environmental interventions: A review of public health department programs*. Lowell: Environmental Health Initiative, University of Massachusetts Lowell and Asthma Regional Council of New England.

Laster, N, Holsey, C. N., Shendell, D. G., McCarty, F., & Celano, M. (2009). Barriers to asthma management among urban families: Caregiver and child perspectives. *Journal of Asthma*, *46*, 731-739.

Liu, A. H., Zeiger, R., Sorkness, C., Mahr, T., Ostrom, N., Burgess, S., . . . Manjunath, R. (2007). Development and cross-sectional validation of the childhood asthma control test. *Journal of Allergy and Clinical Immunology*, *119*, 817-825.

Mizan, S. S., Shendell, D. G., & Rhoads, G. G. (2011). Absences, extended absences, and repeat tardiness related to asthma status among elementary school children. *Journal of Asthma*, *48*, 228-234.

Montana Asthma Control Program, Chronic Disease & Health Promotion Bureau. (n.d.). *Request for application announcement 2014 school nurse mini-grants*. Retrieved from http://asthmamontana.com/school-nurses/

Moorman, J. E., Akinbami, L. J., Bailey, C. M., Zahran, H. S., King, M. E., Johnson, C. A., & Liu, X. (2012). *National surveillance of asthma: United States, 2001-2010* (Vital Health Statistics, Series 3, No. 35). Hyattsville, MD: National Center for Health Statistics.

National Asthma Education and Prevention Program. (2007). *Third expert panel on the diagnosis and management of asthma* (Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma). Bethesda, MD: National Heart, Lung, and Blood Institute. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK7232/

National Asthma Education and Prevention Program. (2008). Guidelines implementation panel report for Expert Panel Report 3—Guidelines for the diagnosis and management of asthma. Bethesda, MD: National Heart, Lung, and Blood Institute.

Schatz, M., Sorkness, C. A., Li, J. T., Marcus, P., Nathan, R. A., Kosinski, M., . . . Jhingran, P. (2006). Asthma control test: Reliability, validity, and responsiveness in patients not previously followed by asthma specialists. *Journal of Allergy & Clinical Immunology*, *117*, 549-556.

Shendell, D., Env, D., Alexander, M., Sanders, D., Jewett, A., & Yang, J. (2010). Assessing the potential influence of asthma on student attendance/absence in public elementary schools. *Journal of Asthma*, *47*, 465-472.

Townsend, K. J., & George, M. (2011). What is the evidence that environmental remediation programs are effective in urban children with allergic asthma? *Journal of Asthma & Allergy*, *2*, 295-305.