A Community-Based Strategy for Improving Asthma Management and Outcomes for Preschoolers

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ABSTRACT Although almost one in ten (8.6%) preschool children has been diagnosed with asthma, few asthma management programs are designed for parents of preschool children. The Asthma Basics for Children program addressed this need in 2003–2008 by implementing a multi-layered approach that offered educational activities to center staff, parents, and children and PACE training to physicians in 31 Northern Manhattan daycare centers. Following program participation, 85% of parents reported reducing their child's triggers, 89% said it was easier to talk to their child's physician, and 80% were confident in their ability to manage their child's asthma. Children's any daytime symptoms dropped from 78% to 42%, any nighttime symptoms from 81% to 49%, any daycare absences from 56% to 38%, any asthma-related emergency department (ED) visits from 74% to 47%, and any asthma-related hospitalizations from 24% to 11% ($p < .001$ for all differences). Outcomes varied by level of exposure. In the Center-Only group (no parent participation), the only reduction was from 19% to 10% (McNemar=3.77, $p = .052$) in hospitalizations. Children whose parents participated in the program had significant reductions in daycare absences (62% to 38%, McNemar=11.1, $p < .001$), ED visits (72% to 43%, McNemar=19.2, $p < .001$), and hospitalizations (24% to 11%, McNemar=5.54, $p = .018$). Children whose parents and healthcare provider participated had the greatest improvements with asthma-related daycare absences dropping from 62% to 32% (McNemar=9.8, $p = .001$), ED visits from 72% to 37% (McNemar=14.4, $p < .001$), and hospitalizations from 35% to 15% (McNemar=8.33, $p = .003$). This study demonstrates that a multi-layered approach can improve asthma outcomes among preschoolers with a combination of parent and provider education having the greatest impact.

KEYWORDS Early childhood centers, Asthma, Self-management training, Indoor trigger reduction, Community-based interventions

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INTRODUCTION

Almost one in 10 (8.6%) children under the age of 6 years has been diagnosed with asthma.¹ Although the asthma-related emergency department (ED) visit and hospitalization rates for this age group are more than twice that of older children,² only a handful of programs are designed to promote improved asthma management by their parents.^{3–11} Millions of low-income preschool children participate in licensed early childhood education programs offering great potential to reach parents at a time when they are motivated and able to get involved in their children's development.^{12,13}

An assessment conducted by the Northern Manhattan Community Voices Collaborative, an academic-community partnership, documented the need for an asthma intervention targeting preschool-age children in Northern Manhattan, New York City. With funding from CDC's Controlling Asthma in America's Cities Project, the collaborative established the Northern Manhattan Asthma Basics for Children Initiative (ABC), a coalition of community service organizations, early childhood educators, parenting programs, and community pediatric providers, and developed the ABC program. The ABC program adapted the Wee Wheezers program^{3,11} for implementation by daycare centers in low-resource communities by (1) shifting responsibility for parent education from nurses to social workers and trained health educators, as in other community-based asthma coalitions;¹⁴ (2) adding peer counselors to assist with tailoring the program to these communities;^{14–16} (3) promoting parent participation by offering flexible workshop scheduling complemented by alternative modalities, such as videos with facilitated discussion; (4) reinforcing messages to parents through daycare center activities for their children; and (5) adding a provider-education component to improve communication between parents and providers. This paper describes the impact of this comprehensive, multi-layered intervention throughout 2003–2008.

METHODS

Intervention

Intervention Setting and Partners The intervention was conducted in two contiguous communities with some of the highest early childhood asthma hospitalization rates in the city¹⁷—Washington Heights, which is 71% Latino, and Harlem, which is 67% African-American. One third of residents live at or below the poverty level.¹⁸ Prevalence of diagnosed or possible asthma in the community's Head Start programs is 30%.¹⁹

Directors of 31 of the invited 35 non-parochial, group early childhood centers signed a memorandum of understanding with ABC, agreeing to participate in the ABC evaluation program, and providing written informed consent as part of the evaluation protocol approved by the Columbia University Institutional Review Board (#AAAB1272).

Intervention Components Table 1 shows ABC intervention components and the division of labor between ABC and partner early childhood center staff.

Curriculum. Before ABC program initiation, the citywide Asthma Child Care Consortium assisted with the adaptation of the Wee Wheezer program. Further

TABLE 1 Division of labor for ABC intervention components

Component	ABC staff	Early childhood center staff
Training and staff support	X	
Identification of children with asthma		X
Parent educational workshops (2-h sequence)	X	
Parent education activities		X
Child education activities	X	X
Making the center asthma-friendly		X
Primary care provider linkage and education	X	
Evaluation and feedback	X	

adaptation for use in the ABC community appears in “Asthma Basics for Children: Early Childhood Educator’s Handbook;” “Asthma Basics for Children: Instructor’s Guide,” a training curriculum; and “Asthma Basics for Children: Parent’s Handbook,” a companion handbook with an average 8th-grade reading level for participating parents or legal caregivers (both referred to as “parents” throughout this paper). The materials are available in English and Spanish from the Asthma and Allergy Foundation of America and the 2009 parents handbook update at www.asthmabasics.org^{20–22}

Staff Training and Support. The ABC program director used the ABC early childhood educator’s handbook in a 4-h participatory training for teachers, social workers, and relevant ancillary staff. The training covered the basics of asthma and asthma management, helping parents communicate with their children’s physician about asthma, identifying children with asthma and requesting an asthma action plan (AAP), trigger assessment and reduction at the center, and engaging and teaching children and parents about asthma. All staff members received a handbook, and centers received copies of the National Collaborative Inner City Asthma Study (NCICAS) film “Roxy to the Rescue” (English and Spanish)²³ and additional parent asthma-education materials. The ABC program manager provided additional mentoring to a lead person chosen by each center to assist with parent education workshops.

The ABC team trained parent asthma mentors (peer counselors) to assist with outreach and mobilization of parents at the 12 largest centers. The mentors were required to complete the ABC parent education workshops, successfully control their child’s asthma, and be Spanish-speaking or bilingual and able to work 8 h/week at the center, for which they received a small monthly stipend. The bilingual ABC program manager gave the mentors 24-h of training, using the ABC early childhood educator’s handbook and train-the-trainer curriculum with additional material on community health worker communications and outreach.

Identification of Children with Asthma. During intake at the beginning of each school year parents completed a one-page, bilingual asthma-symptom assessment to determine whether their child had asthma or any symptoms consistent with asthma. Parents reporting either were asked additional questions about asthma severity and management during this initial assessment or their first workshop. The parent asthma mentors followed-up individually with parents who had not completed the assessment.

Parent Asthma-Education Workshops. Parents whose child had an asthma diagnosis or any symptom consistent with asthma were invited to enroll in the ABC asthma program by signing informed consent forms. They received additional information about the program and an AAP for their physician. Parents whose child had symptoms consistent with asthma were encouraged to talk to their child's doctor about a possible diagnosis. ABC staff conducted two 1-h parent workshops for enrolled parents, usually in conjunction with parent meetings. These sessions covered asthma basics, the child's asthma signs, response to a child's asthma flare-up, asthma medications, the AAP, and trigger identification and reduction. Parents role-played doctor visits, learned how to ask questions about their child's asthma, and received a menu of questions for the doctor. Attendees also received the ABC parent's handbook in the language of their choice.

Supplemental Parent Asthma Education Activities. Center staff supplemented parent asthma education activities with the NCICAS film "Roxy to the Rescue," "Ask the Doctor" sessions with community pediatric partners, and campaigns targeting specific environmental triggers. The parent asthma mentors offered periodic one-on-one question and answer (Q&A) opportunities when parents picked up or dropped off children. Parents were also invited to participate in an annual ABC community asthma forum and walk.

Child Asthma Education. Each center included asthma education games and activities on asthma signs and triggers in its health units, as outlined in the ABC early childhood educators' handbook. Centers were invited to participate in an annual asthma poster competition, which involved the Sesame Street video "A Is for Asthma,"²⁴ additional asthma education games, and poster preparation.

Asthma-Friendly Centers. ABC trained teachers and janitorial and kitchen staff on asthma trigger reduction, using the ABC trigger checklist included in the ABC early childhood educator's handbook, and asked centers to implement as many steps as possible. Center staff members were asked to request an AAP for any child with diagnosed asthma, so that they would know who had asthma and the plan for action in the event of a flare-up. Teachers also received training on handling an asthma flare-up.

Primary Care Physician Linkages. ABC invited physicians identified by parents at enrollment to a quarterly Physician Asthma Care Education (PACE) 4-h training.²⁵ In addition to clinical training, provider education stressed communication with the parents, involved role plays to practice listening and eliciting information in a non-threatening manner, and included the distribution of a list of questions to ask parents.

Evaluation

Data Collection ABC used the following sources to evaluate program effectiveness:

- ABC baseline surveys from all parents enrolling their children in the early childhood center. Part 1 screened for asthma or asthma symptoms, using questions from the International Study of Asthma and Allergies in Childhood

and subsequent validated adaptations.^{7,19} Part 2, completed only by parents of a child with an asthma diagnosis or symptoms, included 13 additional questions regarding asthma and asthma management in the past month, two months, and 6 months, using different time intervals appropriate for the type of asthma outcome and level of detail to be recalled.

- ABC follow-up surveys from all parents with enrolled children completed 9–12 months after enrollment in the ABC program or at end-of-the-school-year events. The surveys repeated baseline questions about asthma symptoms, with a 6-month reference period, and included questions about the parent's asthma management, participation in the ABC program, and asthma-trigger-reduction steps. A parent asthma mentor contacted those who did not attend the event, either face-to-face at the center or by phone. A bilingual research assistant followed-up by phone with parents whose children had graduated from daycare. Parents received small incentives for follow-up completion.
- Asthma management knowledge surveys administered to early childhood center staff and parents participating in the ABC training and education workshops. A six-question parent survey focused on asthma basics, symptoms, triggers, and differences in medications. A ten-question staff survey covered the same topics with additional questions on asthma symptoms and management.
- Sign-in sheets and ABC activity tracking forms submitted by ABC staff and participating centers for each activity conducted at the centers, listing the date, type of activity, number of participants, and event leaders.
- ABC center annual end-of-the-year feedback forms completed by center directors, reports asthma-friendly activities (including trigger assessment and reduction steps), asthma awareness events not listed in the activity logs, and number of AAPs collected.

Data Classification A child was considered to have asthma when a parent reported at baseline survey that the child's healthcare provider had diagnosed asthma. A child was considered to have possible asthma when a parent reported no diagnosis, but the child had symptoms consistent with asthma (wheezing, whistling in the chest, or a cough longer than a week; trouble sleeping because of wheezing, whistling, or cough; taking albuterol to breathe more easily); or making an emergency physician or hospital visit because of breathing problems.

Parents who gave written consent and completed the baseline survey were considered enrolled. Parents who attended at least one ABC educational workshop, as reported by the activity logs or self-report at follow-up, were considered participants. Participation records for the seven parents with two children in the program were attached for both children. A child whose class had participated in at least one child activity was coded as participating in an asthma activity. Participation by the child's healthcare provider of record was identified from a list of local providers completing the PACE program. The asthma activity tracking logs and annual feedback forms were used to assess center participation. All data related to the center, parent, child, or physician were linked to the child's record via the child's unique identifier in the ABC database.

Data Analysis This manuscript describes participation and changes in asthma knowledge for participants at three levels: centers, parents of children (and the children themselves), and healthcare providers. Detailed outcomes, i.e., changes in knowledge,

attitudes, and behavior regarding asthma management, and reported changes in asthma control and asthma-related healthcare utilization, are reported only for the subset of parents who completed both the baseline and follow-up surveys.

Outcomes were measured by changes in a child's asthma control and parents' management, based on the differences between baseline and follow-up surveys completed 9–12 months later. Behavioral outcomes evaluated were parental confidence in managing asthma and success in obtaining an AAP from the child's physician. Asthma-control outcomes included daytime symptoms in the preceding 2 weeks; nighttime symptoms in the preceding month; and asthma-related ED visits or hospitalizations and daycare absences in the preceding 6 months.

Children were grouped by their level of exposure to the program (see “[Outcome Analysis](#)” below). Data were tested for significant differences in asthma management behaviors and control outcomes between baseline and follow-up outcomes within exposure groups, as well as for differences between exposure groups at follow-up. The analysis used the two-sample *t* test to compare mean differences; the two-sample *z* test to compare proportions; the McNemar's *t* test to compare paired, dichotomous values; the Chi-square test for independence (referred to as Chi-square); and the Stuart–Maxwell test for changes in the distribution of categorical outcome events. Stata 9.0 was used for all analyses.

RESULTS

Participation

Centers Enrollment at the 22 Head Start and nine daycare programs ranged from 35 to 220 children per center. The annual staff training reached 808 individuals. All sites implemented at least one trigger-reduction activity, most commonly removing “reading rugs,” dusting children's cubbies, or cleaning radiators and air conditioner filters, and requested AAPs for children with diagnosed asthma. At follow-up, 34% of the children with diagnosed asthma had an AAP on file. Of the centers, 77% included asthma games in their curriculum and 84% participated in the annual ABC poster competition program, involving 1,378 children (441 with asthma) (Table 2).

Parents Across all years, 64% of the 9,279 parents completed the first part of the baseline survey. One third (32%) of the children of parents completing part 1 of the baseline survey ($n=1,908$) had asthma or symptoms consistent with asthma. Their participation is summarized in Table 2. Participation rates did not differ between parents of children with diagnosed asthma and children with symptoms consistent with asthma ($p=.149$). Only one parent per family, almost always the mother, completed the form and was formally tracked in the database.

Children Of the 871 children whose parents enrolled in the program, 633 had an asthma diagnosis and 238 had symptoms consistent with asthma. Children in the program had an average age of 4.1 years, with 56% male, 80% Latino, 15% African American, and the balance of white or Asian descent. Spanish was the primary language for 52% of their parents.

Healthcare Providers Over half (55%) of the participating children's healthcare providers completed the PACE training.

TABLE 2 Participation in the ABC program, 2003–2008

Intervention level and activity	Number (%) of total	Number (%) of participants
Early childhood centers (n=35)		
Signed MOU with ABC	31 (89)	
Completed staff training and at least 1 trigger reduction, requested AAPs, and offered parent education		31 (100)
Offered two or more types of parent education		30 (97)
Included asthma games in the curriculum		24 (77)
Participated in poster competition		26 (84)
Parents ^a of children with asthma or symptoms consistent with asthma per case identification form (n=1,908)		
Participated in at least 1 educational activity	1,374 (72)	
Enrolled in ABC program	871 (46)	
Completed both sessions of ABC workshop		535 (61)
Completed both baseline and follow-up assessments		346 (40)
Pediatric health care providers in the community (n=306)		
Participated in PACE training	183 (59)	
Children with asthma or symptoms consistent with asthma enrolled in the program (n=871)		
Children with diagnosed asthma	633 (73)	
Children with diagnosed asthma and both baseline and follow-up assessments	249 (29)	
Center activity exposure only		84 (34)
Center activity exposure and parental participation		103 (41)
Center activity exposure and PACE-trained physician		9 (4)
Center activity exposure, parental participation and PACE-trained physician		53 (21)

^aOnly one parent was counted when more than one parent or guardian participated

Change in Knowledge of Asthma Management

Knowledge among staff completing both pre- and post-tests (n=357) increased from 49% to 82% correct responses. Asthma management knowledge among parents completing both pre- and post-tests (n=395) rose from 62% to 79% correct responses. Of providers participating in the PACE training (n=100), 84% reported adopting at least one recommended practice change, with the biggest being an increase from 47% to 70% in AAP use.

Outcome Analysis

Analysis was restricted to children with diagnosed asthma at baseline (n=249) whose parents completed at least one follow-up form. Children with asthma symptoms but no diagnosis were excluded because it was assumed that their parents were likely to have different levels of participation and uptake of the program recommendations. The only significant difference among the children with diagnosed asthma by parental follow-up completion was age, with those completing the follow-up younger than those whose parents did not complete the follow-up. This age difference was attributed to the difficulty of following children who had transitioned to elementary school during the summer.

All children in the intervention group were exposed to programs and environmental changes implemented through their daycare centers. Exposure increased depending on additional participation by their parents or medical provider. To isolate each layer's impact, outcomes were analyzed by grouping children into the following three exposure categories.

- *Center Intervention Only (CO)*. Children whose parents did not participate in any ABC parent education activities and whose providers did not complete the PACE training ($n=84$)
- *Center±Parents Participated (CP)*. Children whose parents participated in at least one ABC parent education workshop but whose providers did not complete the PACE training ($n=103$)
- *Center±Parents±Physician Participated (CPP)*. Children whose parents participated in an ABC parent education workshop and whose physician completed the PACE training ($n=53$).

The nine children whose parents did not participate in the program but whose physicians completed the PACE training program were excluded, because these were too few cases to analyze separately. For the remaining subset of 240 children with diagnosed asthma, completed baselines, and follow-ups, results are reported first for all children and then by the child's level of exposure.

Because children were not randomly assigned to each of the three exposure groups, the first test for significant differences was between exposure groups at baseline (data not shown). There were no significant differences between the exposure groups in the children's daytime (Chi-square=3.81, $p=.149$) or nighttime symptoms (Chi-square=4.52, $p=.104$), having an AAP from the child's physician (Chi-square=1.84, $p=.399$), feeling confident managing asthma (Chi-square=3.23, $p=.199$), or ED visits in the past year (Chi-square=0.101, $p=.951$). While the CP and CPP groups had slightly higher proportions of hospitalizations in the past year, the differences were not significant at a .05 level (Chi-square=5.64, $p=.060$).

Overall Asthma Control Outcomes for Parents and Children with Diagnosed Asthma As shown in Table 3, between baseline and follow-up parents' asthma management behaviors increased significantly. At follow-up, 85% of the parents reported having taken steps to reduce environmental triggers and 89% found it easier to talk to their doctor. The proportion of parents who received an AAP increased from 46% to 57% (McNemar=5.9, $p=0.014$), and who reported feeling confident managing their child's asthma increased from 57% to 81% (McNemar=21.4, $p<.001$).

All asthma control outcomes improved (Table 3). The percent with any daytime symptoms in the previous 14 days dropped from 78% to 42%, while any nighttime symptoms in the previous month decreased from 81% to 49%. The percent of children with any daycare absences due to asthma dropped from 56% to 38%. The percent with any hospitalization dropped from 24% to 11%. (All differences significant at $p<.001$ by McNemar's test).

As shown in Figure 1, for every symptom the proportion of children with *no* reported symptoms doubled at follow-up with a similar shift in the distribution of symptoms from high- (3+) to low-frequency (1–2) categories. The proportion of children with no nighttime symptoms rose from 19% to 52% (McNemar=42.88, $p<.001$). Similar patterns were observed for daytime symptoms and ED visits; no daytime symptoms increased from 22% to 59% (McNemar=52.6, $p<.001$) and no

TABLE 3 Asthma management and control outcomes for children with diagnosed asthma

	Baseline	Follow-up
Parents asthma management behaviors (Baseline vs. Follow-up)		
Took any steps to reduce triggers	N/A	85%
Easier to talk to doctor	N/A	89%
Obtained AAP from primary care provider	46%	57%
Confident of ability to manage child's asthma	57%	80%
Child's asthma control outcomes (Baseline vs. Follow-up)*		
Had any daytime symptoms in previous 14 days	78%	42%
Had any nighttime symptoms in previous month	81%	49%
Had any asthma-related daycare absences in previous 6 months	56%	38%
Had any asthma-related ED visits in previous 6 months	74%	47%
Had any asthma-related hospitalizations in previous 6 months	24%	11%

**p*<.001; all differences between baseline and follow-up outcomes are significant

ED visits increased from 25% to 53% (McNemar=16.5, *p*<.001). Among children with *any* nighttime symptoms at baseline, 62% had a reduction in nighttime symptom frequencies at follow-up (Stuart–Maxwell=42.8, *p*<.001). Among those with daytime symptoms one to two times per week, 56% had reductions to none, and 85% with symptoms three or more times per week had reductions to one to two or none per week (Stuart–Maxwell=52.6, *p*<.001). In addition, two thirds (68%) of the parents reported a reduction in ED visit, with 63% of those with one ED visit reporting none at follow-up, 85% of those with two visits reporting 0 or one ED

Note: Nighttime symptoms (n=181) are per month, for the previous month. Daytime symptoms (n=206) are per week, for the previous 14-day period. ED visits (n=181) are for the previous 6 months.

FIGURE 1. Percent of children with diagnosed asthma by frequency of nighttime and daytime symptoms and ED visits, baseline vs. follow-up at 9-12 months.

visit, and 77% of those with 3+ ED visits reporting two or fewer visits (Stuart–Maxwell=73.2, $p<.001$).

Changes in Parent's Asthma Management Behaviors by Level of Exposure As shown in Figure 2, adoption of recommended asthma management behaviors increased with each level of program exposure. In the CO group, only 31% had taken at least one step toward reducing triggers, 49% reported that talking to their child's doctor was easier, and 49% expressed confidence in managing their child's asthma. In the CP group, those reporting these behaviors increased to 40%, 62%, and 71%, respectively, while the CPP or highest exposure group, reported increases in these behaviors of 76%, 82%, and 86%, respectively. (All differences by level of participation are significant at the .001 level.) Gains in parental confidence in managing asthma increased significantly for the CP and CPP groups—from 58% to 88% and from 49% to 92%, respectively ($p<.001$, McNemar=12.5 and 13.7, respectively). Having an AAP for their child at follow-up was the only management behavior not responsive to level of exposure.

Reduced Daytime and Nighttime Symptoms by Level of Exposure All exposure groups reported significant reductions in daytime and nighttime symptoms. Reductions varied by exposure group for daytime but not nighttime symptoms. Daytime symptom reduction was reported by 67% of the CO group, 56% of the CP group, and 74% of the CPP group, with the CPP group's reduction in daytime symptoms significantly greater than the CP group's ($p=.036$). Reductions in nighttime symptoms were comparable for all groups, i.e., reported by 66% of the CO group, 60% of the CP group, and 63% of the CPP group.

Daycare Absences by Level of Exposure As shown in Figure 3.1, daycare absences did not change between baseline and follow-up for children in the CO group. The percent with any asthma-related daycare absences dropped significantly in each of the CP and CPP groups, but the difference between the two groups (Figure 3.1) was not significant.

Note: Parents of children with diagnosed asthma only ($n=227$). Follow-up conducted 9–12 months after baseline.

FIGURE 2. Percent of parents reporting selected asthma management behaviors at follow-up by level of program exposure.

3.1: Percent with Any Asthma-related Daycare Absences in Previous 6 Months
(n= 50 in CO, 84 in CP, 47 in CPP)

Note: McNemar test chi-square for baseline versus follow-up (p value):
CO group=0.048 (p=.827); CP group=11.1 (p<.001); CPP group=9.80 (p=.001)

3.2: Percent with Any Asthma-Related ED Visits in Previous 6 Months
(n=41 in CO, 83 in CP, 54 in CPP)

Note: McNemar test chi-square for baseline versus follow-up (p value):
CO group=2.57 (p=.108); CP group=19.2 (p<.001); CPP group=14.4 (p=.001)

3.3 Percent with Any Asthma-Related Hospitalizations in Previous 6 months
(n=73 in CO, 93 in CP, 48 in CPP)

Note: McNemar test chi-square for baseline versus follow-up (p value):
CO group=3.77 (p=.052); CP group=5.54 (p=.018); CPP group=8.33 (p=.003)

FIGURE 3. Children's asthma control outcomes by level of program exposure, baseline vs. follow-up at 9-12 months.

Emergency Department Visits by Level of Exposure As seen in Figure 3.2, ED visit rates also dropped for all groups, with the greatest drops in the CP and CPP groups. The CP and CPP groups' reductions were both significantly greater than that of the CO group, while there was no significant difference in the amount of reduction between the CP and CPP groups.

Hospitalizations by Level of Exposure At each higher level of exposure to the program, any asthma-related hospitalizations at follow-up were reduced by

progressively larger amounts (Figure 3.3). Differences between groups in reduction in hospitalizations were not significant.

DISCUSSION

The ABC program effectively reduced asthma-related absences and other asthma morbidity among 2–5 years old attending daycare centers. ABC program results are comparable to, and indeed exceed, the impact observed in other childhood asthma educational interventions.²⁶ Unlike previous parent asthma education programs among preschool-age children,^{3,4,8,10,11} the ABC program achieved positive outcomes through a community-based program without initiation by healthcare providers or as a follow-up to hospitalization, making it more accessible to community daycare programs.³ The ABC program is readily implemented by daycare centers with parent asthma education provided by trained non-medical staff.

Asthma control outcomes improved progressively as the child's exposure to ABC's multi-layered interventions increased. Daycare center staff made the centers more asthma-friendly, ABC and center staff educated parents about asthma management, and the community's pediatric providers received training to provide state-of-the-art care. Center staff had a higher level of participation in the ABC program than found by previous surveys of asthma management at Head Start centers.^{7,27,28} With guidance from the ABC program, the centers tracked children with asthma, requested an AAP from the parent, provided an "asthma-friendly" environment for the children, and taught children to recognize asthma symptoms, be alert to triggers, and respond to the signs of an incipient asthma exacerbation. These center activities likely contributed to the improved asthma outcomes among children whose parents did not actively participate in the education program.

The program focused on achieving high parent participation rates by providing multiple opportunities for parental participation in an asthma education program. Parent participation rates in our study exceeded most rates found in other preschool or school-based asthma programs, which reported participation rates of 25%,⁶ 52%,²⁹ and 64%.³ As suggested by Coffman and colleagues,²⁶ providing more opportunities for interactive learning may increase the effectiveness of asthma education programs. ABC's high participation rates appear to result from offering accessible and fun activities, such as a popular, entertaining film, a community asthma forum, an asthma walk, and a community doctor Q&A with repetition of events at different times and dates to further facilitate program access. This strategy appears to have paid off with increased improvements in asthma outcomes among children whose parents participated in the program.

Another key element of the ABC strategy was linking asthma education activities in the daycare setting with improving the quality of asthma care by healthcare providers. Similar to other studies of parental concerns,^{26,30} parents in this program confided that they were often reluctant to share concerns with their physician, especially about possible side effects of daily controller use. After participating in the program 89% found it easier to talk to their doctor. The two-pronged strategy of strengthening communication skills of parents and their child's healthcare provider is likely to have contributed to the changes in asthma management behaviors, improved confidence, and improved asthma control.

This evaluation has several design-related limitations. Firstly, the pre-post-evaluation design did not include a control group, nor were children randomly assigned to different intervention exposure levels. Despite persistent efforts by the

daycare centers and program staff, some eligible parents did not participate; others failed to complete the program. Some results might be attributable to self-selection by the most motivated parents into higher levels of participation. Secondly, provider participation in the PACE intervention was optional. The more motivated providers may have participated, and motivated parents might have sought out PACE-trained providers. Thirdly, all information about the child's asthma and management was obtained from parental self-report and interviewers could not be blinded to the child's level of participation. Fourthly, parent participation at events hosted by center staff without direct support from the ABC team might have been underreported. Similarly, child participation might have been underestimated if centers failed to report every inclusion of asthma games in their daily activities. Fifthly, asthma improvements could reflect the effects of other asthma interventions in the city and community.

Despite these limitations, this study demonstrates how a multi-layered approach that integrates activities for children, parents, teachers, and the children's healthcare providers can improve asthma outcomes among preschoolers, with the greatest impact occurring when children benefit from education interventions at all three levels. While no documentation of sustainability exists, this multi-layered approach of integrating asthma education and management tools within different systems might provide a model for sustainable asthma programs that link daycare center programs to health systems or other domains.

DISCLAIMER

The findings and conclusions in this manuscript are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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