

Kickin' Asthma: School-Based Asthma Education in an Urban Community

SHERYL MAGZAMEN, PhD, MPH^a
BINA PATEL, MPH^b
ADAM DAVIS, MPH, MA^c
JOAN EDELSTEIN, RN, DrPH^d
IRA B. TAGER, MD, MPH^e

ABSTRACT

BACKGROUND: In urban communities with high prevalence of childhood asthma, school-based educational programs may be the most appropriate approach to deliver interventions to improve asthma morbidity and asthma-related outcomes. The purpose of this study was to evaluate the implementation of *Kickin' Asthma*, a school-based asthma curriculum designed by health educators and local students, which teaches asthma physiology and asthma self-management techniques to middle and high school students in Oakland, CA.

METHODS: Eligible students were identified through an in-class asthma case identification survey. Approximately 10-15 students identified as asthmatic were recruited for each series of the *Kickin' Asthma* intervention. The curriculum was delivered by an asthma nurse in a series of four 50-minute sessions. Students completed a baseline and a 3-month follow-up survey that compared symptom frequency, health care utilization, activity limitations, and medication use.

RESULTS: Of the 8488 students surveyed during the first 3 years of the intervention (2003-2006), 15.4% (n = 1309) were identified as asthmatic; approximately 76% of eligible students (n = 990) from 15 middle schools and 3 high schools participated in the program. Comparison of baseline to follow-up data indicated that students experienced significantly fewer days with activity limitations and significantly fewer nights of sleep disturbance after participation in the intervention. For health care utilization, students reported significantly less frequent emergency department visits or hospitalizations between the baseline and follow-up surveys.

CONCLUSIONS: A school-based asthma curriculum designed specifically for urban students has been shown to reduce symptoms, activity limitations, and health care utilization for intervention participants.

Keywords: child and adolescent health; chronic diseases; evaluation.

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^aDoctoral Candidate, (magzamen@berkeley.edu), Division of Epidemiology, School of Public Health, 50 University Hall, #7360, Berkeley, CA 94720-7360.

^bProgram Associate, (bpatel@alaebay.org), American Lung Association of California, 1900 Powell St, Suite 800, Emeryville, CA 94608.

^cAsthma Program Director, (adavis@alaebay.org), American Lung Association of California, 1900 Powell St, Suite 800, Emeryville, CA 94608.

^dHealth Services Coordinator, (kickasthma@earthlink.net), Oakland Unified School District, Alameda County Department of Public Health, 2850 W St, Oakland, CA 94608.

^eProfessor, (ibt@berkeley.edu), Division of Epidemiology, School of Public Health, 50 University Hall, #7360, Berkeley, CA 94720-7360.

Address correspondence to: Sheryl Magzamen, Associate Researcher, (magzamen@wisc.edu), Robert Wood Johnson Foundation Health & Society Scholars Program, 707 WARF, 610 Walnut Street, Madison, WI 53726-2397.

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Asthma is the most common chronic disease of childhood.^{1,2} In the United States, approximately 12% of children younger than 18 years have been diagnosed with asthma.³ Asthma is the leading cause of school absences due to a chronic disease and accounts for 3 times more lost school days than any other cause.^{4,5} Asthma also is associated with low academic achievement and high likelihood of grade retention.⁶⁻⁸

Asthma has a substantial impact on urban school districts that serve a large proportion of nonwhite and impoverished children.⁹ Asthma-related morbidity, as measured by school absences, hospitalizations, and outpatient emergency care, has been found to be disproportionately high among children living in poverty,¹⁰⁻¹³ as well as black and Latino children.^{2,14-17} Morbidity in nonwhite and impoverished populations has been explained by many factors that include lack of access to primary care,¹⁸ substandard primary care,¹⁹ characteristics of the social environment,^{15,20} and physical environment,^{21,22} as well as the perception of asthma as an acute rather than chronic disease.^{4,23}

Schools in urban communities are logical places to conduct asthma education interventions. Schools are centrally organized locations with broad community access. Previous studies have found that school-based asthma education is cost-effective and garners higher attendance rates compared to clinic-based programs, particularly in urban settings.^{4,24,25} School-based asthma education eliminates issues related to transportation, limited access to health care providers, and lack of parental awareness or knowledge of asthma. Since asthma-related absences also impose a burden on school systems due to the relation between average daily attendance and funding, school systems have a stake in minimizing the financial and educational impact of asthma on students.

As part of the Centers for Disease Control and Prevention (CDC)-funded *Controlling Asthma in American Cities* Project, *Oakland Kicks Asthma* (OKA) (joint venture between the American Lung Association [ALA] of California, University of California, Berkeley, Children's Hospital Oakland, and Oakland Unified School District [OUSD]) conducted a school-based asthma program for adolescent students enrolled in OUSD middle schools and high schools. Adolescent students (aged 11-18 years) have been targeted specifically for services for several reasons. Although hospitalizations and emergency room visits due to asthma are highest at younger ages,¹⁶ adolescents have a higher prevalence of asthma, suffer more frequent exacerbations, and have more near-fatal episodes compared to younger children.^{26,27} Increased morbidity may be explained partly by the fact that parents and guardians may have reduced roles in the management of the child's health as the child matures. However, adolescents often may not be prepared to assume the full responsibility for self-management.²⁸ Further, adoles-

cents face logistical and financial obstacles, such as inadequate transportation, that hinder their capacity to receive care or education independent of parents or guardians. Often, clinical care cannot be provided without parental consent, which, in some cases, may pose a barrier. Despite the added challenges faced by adolescents, relatively few programs and resources have been developed for students with asthma in this age-group. Although programs have specifically been developed for adolescents,²⁶ there are no interventions that target the unique health and social needs of urban adolescents.

The primary objective of this study is to evaluate the effectiveness of the first 3 years of a school-based asthma education program, entitled *Kickin' Asthma*, that targeted middle school and high school students with asthma in the OUSD. The specific aims of this analysis are to ascertain if school-based asthma education significantly reduced asthma symptoms, asthma-related acute care utilization, and school absences among children identified with asthma.

METHODS

OUSD is a public K-12 school system with 42,000 predominantly low-income students. OUSD is one of the most diverse school systems in the country. The student body is 45% African American, 31% Latino, 17% Asian or Filipino, and 5% Caucasian. Approximately 1 of 4 students is an English language learner. The student to nurse ratio is 1800:1, which does not include special education nurses. Few schools have a nurse or health aide.

Principals of each OUSD middle school and high school were approached and given the option to have their school participate in the OKA program. All 15 middle schools and 3 of 7 high schools have participated in the program. All activities conducted under OKA were approved by both the OUSD and the Committee for the Protection of Human Subjects at the University of California, Berkeley.

Case Identification

Starting in 2002, asthma case identification was conducted in participating schools at the start of the school year (SY). The case identification conducted in the OUSD has been described elsewhere.²⁹ Briefly, a self-administered, 14-question survey based on the International Study of Asthma and Allergy in Childhood (ISAAC) questionnaire was given to sixth-grade and ninth-grade students during class at the start of the SY. Although the primary targets of the program were sixth-grade and ninth-grade students, due to mixed-grade classes in the OUSD, a number of students in grades 7-8 and 10-12 completed the case identification survey and subsequently participated in the *Kickin'*

Asthma program. Although there is currently no consensus on a standard definition for asthma,³⁰ the ISAAC survey is an international standardized asthma questionnaire used to describe the prevalence and severity of asthma.³¹ The surveys were designed to be short and easy to complete and to provide important information not available from routine administrative health forms. Prior to administration of the case identification survey, parents were sent a letter that described the project; parental consent was not required to complete the survey. At the time of survey administration, students were permitted to decline to participate.

Approximately 93% of the potential students completed the case identification survey. Students who reported a doctor's diagnosis of asthma in addition to a report of asthma symptoms or a recent emergency room visit on the survey were eligible for the asthma education program.

The Kickin' Asthma Intervention

Kickin' Asthma is a 4-session curriculum developed jointly by ALA staff, OUSD nurses, and OUSD peer educators over a 3-year period. Kickin' Asthma is similar structurally to *Open Airways for Schools*,³² a curriculum designed for children at the elementary school level but with more advanced topics and learning modalities more suitable for adolescents' level of cognition and awareness. The 4 Kickin' Asthma sessions were each taught by an OUSD or ALA nurse during 1 period, about 50 minutes in length, and were spaced 1 week apart. The 4 sessions covered (1) lung physiology and asthma basics; (2) triggers, symptoms, and warning signs; (3) medication; and (4) emergencies, problem solving, and review. Each session has optional modules for skits, games, videos, and role-playing scenarios and allowed certain modules to be taught by either the health educator or peer educators. Customized letters were sent home to the parents or guardians of all Kickin' Asthma participants that described the curriculum along with the specific health needs and goals of each student as assessed by the nurse educator.

A review session was held 3 months after the series was completed. All sessions were limited to 15 students. To prevent interference with academic classes, Kickin' Asthma sessions were offered during students' lunch period. Beginning in SY 2004-2005, an ALA staff member was available to assist with Kickin' Asthma recruitment, logistics, and education.

Procedure

In order to facilitate the logistics of program execution, each principal was asked to designate a volunteer staff liaison to work with the health educators to arrange activities. Since all Kickin' Asthma sessions were voluntary, a series of intense recruitment efforts were conducted to encourage participation in the program. Students who were eligible for the Kickin' Asthma series were sent colorful, personalized "invitations" through their teacher's mailboxes. These invitations highlighted the fun aspects of the asthma sessions, such as free food, friends, and games. On the day of the session, students were reminded to attend by phoning their teacher's classroom right before lunchtime, delivery of reminders to their classrooms, or through announcements over the school's public address system. Lunch was provided for students in each session. Small incentives (\$10 gift card to a video store or an athletic apparel store) were provided for students who completed the program during SYs 2003-2004 and 2004-2005; however, due to budgetary constraints, no incentives were provided during SY 2005-2006. Spacers were provided to students all 3 years; peak flow monitors were distributed during the first 2 years of the intervention.

At the first session and at the beginning of the 3-month review session, students were asked to complete a brief survey that consisted of 11 student-completed asthma indicators (symptom frequency, severity, health care utilization, and self-management) in addition to 5 instructor-completed questions on types of asthma medications and frequency of usage (Table 1). To obtain accurate information about

Table 1. Kickin' Asthma Questions for Baseline/Follow-Up Analysis

Category	Classification	Frequency	Data Format
Symptoms	Daytime symptoms	Previous 4 weeks	Categorical
		Previous 3 months	Categorical
	Nighttime symptoms	Previous 4 weeks	Categorical
Severity	Missed school days	Sleep disruptions, previous 4 weeks	Continuous
		Previous 4 weeks	Continuous
		Previous 4 weeks	Continuous
Health care utilization	Clinical	Unplanned physician visit, previous 3 months	Binary
		Emergency department visit/hospitalization, previous 3 months	Binary
Self-management	Asthma equipment	Spacer use with inhaler?	Categorical
		Peak flow meter use?	Categorical
	Asthma medication	Any medication use when feeling well? (not available question during SY 2003-2004)	Binary

medication use, colored photos of the different types of common medications were shown to the students, and usage information was elicited on a one-to-one basis. Due to the relatively short 4-month period of the evaluation, survey questions on symptoms in previous year were not included in the analysis. In addition, due to the complexity of patterns of medication use, only responses for the medication use when asymptomatic (ie, controller medication) question were included in this analysis.

Statistical Methods

Program Completion. The proportion of children who enrolled in the program was compared to the proportion of children who completed the program by year and by demographics collected on the case identification survey (sex and grade). To evaluate whether there were differences in program completion by asthma indicators, logistic regression was used to calculate the odds of program completion based on all 11 questions (Table 1) reported on the baseline survey.

Ecological-Level Analyses. Each outcome was evaluated for all participants by year based on the format of the data collected on the survey (Table 1). For all ecological-level outcomes, students were only included in each analysis if they completed the question of interest on both the baseline and the 3-month follow-up surveys.

Group-level means (for continuous variables) and proportions (for binary variables) were calculated for baseline and follow-up surveys. Due to the highly skewed distributions of continuous variables, the Wilcoxon signed-rank test for paired data was used to test the significance of the difference from baseline to follow-up for each student. For binary outcomes, odds ratios (ORs) for paired data were used to calculate odds of improvement in behavior postintervention.

For each categorical variable, a "change" outcome variable was created to indicate if the student improved, worsened, or remained at the same level from baseline to follow-up. Multinomial logistic regression was used to calculate the ORs to predict the

change outcome variable based on the frequency reported during baseline. The baseline category chosen for this analysis was no change; ORs were calculated for the comparisons of improvement versus no change and worsening versus no change.

Individual-Level Analysis. An individual asthma morbidity score was calculated for each student who completed both baseline and follow-up surveys. For the 11 variables listed in Table 1, students were given -1 point for each symptom that improved, 0 points for each symptom that remained the same, and +1 point for every symptom that worsened on the posttest compared to the pretest. A summary score, ranging from -11 to 11, was then calculated for each student. Median scores, interquartile range (IQR), as well as minimum and maximum scores are presented for the 3 years of analysis. All analyses were performed with SAS version 9.0 (SAS Institute Inc., Cary, NC).

RESULTS

For the 3 SYs included in this analysis, 8488 students completed the case identification questionnaire; 1309 students (15.4%) were eligible for the Kickin' Asthma program (Table 2). Eighty-six Kickin' Asthma series were conducted in 15 middle schools and 3 high schools. During SY 2004-2005, 99% of eligible students participated in at least 1 session. However, during SYs 2003-2004 and 2005-2006, 52% and 79% of eligible students participated in at least 1 session, respectively. For the first 2 years of the intervention, over 50% of enrolled students completed a 3-month follow-up survey; this percentage declined to 48.1% during SY 2005-2006.

Attendance records completed by the Kickin' Asthma staff indicated that on average, 50% of students who enrolled in the program attended each class in the 4-part series (data not shown). During SY 2004-2005, 81% (n = 334) of enrolled students attended all 4 classes; in SY 2005-2006, this percentage declined to 35% (n = 123). Attendance data were not available for SY 2003-2004.

Table 2. Enrollment in the Kickin' Asthma Intervention

	SY 2003-2004*		SY 2004-2005*		SY 2005-2006	
	n	% Previous Category [†]	n	% Previous Category [†]	n	% Previous Category [†]
Number of schools surveyed [‡]	11		17		13	
Number of students surveyed	2387		2722		3379	
Number of students eligible for Kickin' Asthma	381	16.0	440	16.2	488	14.4
Number of students enrolled in Kickin' Asthma [§]	200	52.4	438	99.5	352	71.9
Number of students completed 3-month follow-up	113	56.5	231	59.2	169	48.1

*Incentives for program completion offered during SYs 2003-2004 and 2004-2005.

[†]Percent is derived from category as numerator and preceding category count as denominator.

[‡]Includes only schools that offer Kickin' Asthma program to students.

[§]Enrolled defined as attended first Kickin' Asthma class.

Program Completion. Of the students eligible, 30% enrolled and completed the 3-month follow-up survey during SY 2003-2004 (Table 2). This proportion increased to 47% during SY 2004-2005 and declined to 34% during SY 2005-2006. For SY 2005-2006, the number of children who attended the 4-part Kickin' Asthma series was less than the number of students who completed the 3-month follow-up survey. It is likely that students who enrolled in Kickin' Asthma missed several classes but were still able to complete the 3-month follow-up survey. Detailed attendance records were not available to verify this hypothesis.

In terms of demographic information, a significantly greater proportion of sixth-grade students enrolled in the program compared to the proportion eligible, for both females (5.9%, 95% CI for difference: 1.7-10.2) and males (5.1%, 95% CI for difference: 0.8-9.4) (Table 3). Likewise, a significantly smaller proportion of eighth-grade students enrolled in the program compared to the proportion eligible, for both females (-4.6%, 95% CI for difference: -6.1 to -3.1) and males (-4.2%, 95% CI for difference: -5.6 to -2.8). Slightly more males (50.2%) compared to females enrolled in the Kickin' Asthma program. The proportion of males and females who completed the program was equal to the proportion of enrollment by sex. Sixth-grade students accounted for the largest percentage of enrollment in the program (83.1%) as well as completion (75.3%). The difference in enrollment versus completion percentages for sixth graders compared to all other students was significantly different (7.8%, 95% CI for difference: 2.8-12.7). However, there were no significant differences in proportion of enrollment and completion by sex and grade.

Baseline surveys were compared for students who did and did not complete the 3-month follow-up survey to assess if there were significant differences in symptoms, severity, health care utilization, and self-management between these groups. For SY 2003-2004, the odds of program completion increased for each additional physician visit reported (OR: 1.36, 95% CI: 1.04-1.78). For SY 2004-2005, the odds of program completion were slightly less for each addi-

tional day of activity limitations reported (OR: 0.94, 95% CI: 0.89-0.99). For SY 2005-2006, students were less likely to complete the follow-up for each additional day of school absence reported (OR: 0.84, 95% CI: 0.74-0.95) but had greater odds of completion if they reported peak flow meter use (OR: 1.81, 95% CI: 1.18-2.78). No significant differences were found for other items on the survey.

Ecological-Level Analyses. Group-level means and mean differences for continuous variables (missed days of school, nights of sleep disruption, and activity limitations) are presented in Table 4. For SY 2003-2004, average missed days of school was significantly reduced by 0.54 days (SE: 0.300, $p < .03$) for enrolled students who completed the follow-up survey. Average missed days of school also decreased significantly during SY 2004-2005 (mean decrease: 0.26 days, SE: 0.119, $p < .01$), although the magnitude of change was less than the previous SY. SY 2005-2006 had a small and nonsignificant difference in average missed days of school for students from baseline to follow-up. Average number of nights of sleep disruption decreased from baseline to follow-up for every year, although the magnitude of change decreased over time, and change during SY 2005-2006 was not significant. The opposite pattern emerged for number of days of activity limitations reported. There were significant differences in number of days with activity limitations from baseline to follow-up for all 3 years of the program. In SY 2005-2006, students reported a mean decrease of 1.12 days (SE: 0.370, $p < .0001$) with activity limitations after participation in the Kickin' Asthma series.

Group-level proportions and individual-level ORs of improvement in binary variables (medication and health care utilization) are presented in Table 5. Comparing baseline data to follow-up data, the OR of improvement in medication use when asymptomatic was 1.63 (95% CI: 1.08-2.88) during SY 2004-2005 but was not significant during SY 2005-2006. For all 3 years of the program, the OR for a reduction in emergency department utilization or hospitalization due to asthma was positive and significant. For SY 2003-2004, the OR for an improvement in physician visits for asthma symptoms was 3.00 (95% CI: 1.41-6.39).

Table 3. Demographics (Sex and Grade) for Kickin' Asthma Intervention

	Sex		Female				Male			
	Grade	6	7	8	9-10	6	7	8	9-10	
Number (%) of students surveyed (n = 8085)*		2872 (35.5)	163 (2.0)	536 (6.6)	462 (5.7)	2929 (36.2)	147 (1.8)	523 (6.5)	453 (5.6)	
Number (%) of students eligible for Kickin' Asthma (n = 1258)*		433 (34.4)	36 (2.9)	73 (5.8)	84 (6.7)	473 (37.6)	18 (1.4)	68 (5.4)	73 (5.8)	
Number (%) of students enrolled in Kickin' Asthma (n = 845)*		341 (40.3)	21 (2.5)	10 (1.2)	49 (5.8)	361 (42.7)	16 (1.9)	10 (1.2)	37 (4.4)	
Number (%) of students completed baseline and 3-month follow-up (n = 397)*		147 (37.0)	12 (3.0)	6 (1.5)	33 (8.3)	152 (38.3)	11 (2.8)	6 (1.5)	30 (7.6)	

*Percentages were completed based on the number of children who had sex and grade information available from case identification survey.

Table 4. Comparison of Baseline and Follow-Up Survey Results for Continuous Variables

	SY 2003-2004			SY 2004-2005			SY 2005-2006			
	Pretest Mean (95% CI)	3-Month Follow-Up Mean (95% CI)	Mean of Individual Difference (SE); p*	Pretest Mean (95% CI)	3-Month Follow-Up Mean (95% CI)	Mean of Individual Difference (SE); p*	n	Pretest Mean (95% CI)	3-Month Follow-Up Mean (95% CI)	Mean of Individual Difference (SE); p*
Missed days of school	1.12 (0.49-1.74)	0.58 (0.31-0.85)	0.54 (0.300); p < .033	0.98 (0.75-1.21)	0.72 (0.52-0.92)	0.26 (0.119); p = .0103	160	0.93 (0.67-1.19)	0.85 (0.57-1.12)	0.08 (0.130); p = .4387
Nights of sleep disruptions	1.03 2.42 (1.74-3.09)	1.43 (1.01-1.85)	0.99 (0.293); p < .006	2.34 (1.92-2.75)	1.66 (1.23-2.09)	0.68 (0.269); p < .0001	162	2.17 (1.52-2.83)	1.74 (1.09-2.39)	0.43 (0.404); p = .0055
Activity limitations	98 3.06 (2.30-3.83)	2.36 (1.67-3.04)	0.70 (0.363); p < .015	3.38 (2.87-3.89)	2.76 (2.17-3.36)	0.62 (0.338); p < .0001	158	3.36 (2.65-4.07)	2.24 (1.63-2.85)	1.12 (0.370); p < .0001

CI, confidence interval; SE, standard error.
*p Values are calculated from Wilcoxon signed-rank test for paired data.

Although the odds of improvement in physician visit were positive for the 2 other years of the program, there was not a significant improvement in physician visits for SY 2005-2006 (OR: 1.21, 95% CI: 0.74-2.00).

Table 6 describes the changes in outcomes for the 5 categorical variables included in the survey: daytime symptoms (previous 4 weeks and previous 3 months), nighttime symptoms (previous 3 months), peak flow meter use, and spacer use. Overall, 80% of the categories had a greater number of students improve compared to worsen after participation in the Kickin' Asthma program. ORs were calculated to compare the likelihood of changes for symptom frequency and use of asthma devices from baseline to follow-up to no change, given the student's answer at baseline. These ORs should be interpreted in the following manner using previous 4-week symptoms for SY 2003-2004 as an example: for each baseline category of severity, students had nearly twice the odds (OR: 1.92) of improvement in symptoms in the previous 4 weeks compared to no change in daytime symptoms. Similarly, for every baseline value, students were approximately 6% (OR: 0.94) less likely to have worse daytime symptoms than no change in daytime symptoms, although this finding is not statistically significant. Both daytime symptoms (previous 4 weeks) and nighttime symptoms (previous 4 weeks) were significantly more likely to improve compared to no change for each year of the intervention. However, there were no significant differences in the likelihood of worsening compared to no change. In terms of asthma self-management behaviors, ORs for peak flow meter use and spacer use for both change categories were significantly different than no change for every year, except for SY 2005-2006, in which the odds of improvement in peak flow meter use were not significantly different than no change in peak flow meter use.

Individual-Level Analysis. Individual-level changes in asthma morbidity scores for students are presented in Figure 1. Negative scores indicated decreased asthma symptoms from baseline to follow-up (ie, improvement), while positive scores indicated increased asthma symptoms from baseline to follow-up (ie, decline). The median scores were -1.5 for SY 2003-2004 (range: -8 to 5; IQR: -3 to 1) and -2 for both SY 2004-2005 (range: -11 to 4; IQR: -4 to 0) and SY 2005-2006 (range: -9 to 5; IQR: -3 to 0). For SY 2003-2004, 72% of students had a change in score that indicated improvement (<0). The proportion of students with an improvement in score decreased in the following 2 years to 70% and 63%, respectively.

DISCUSSION

The Kickin' Asthma intervention demonstrated measurable and significant improvements for asthma

Table 5. Comparison of Baseline and Follow-Up Survey Results for Binary Variables

	SY 2003-2004			SY 2004-2005			SY 2005-2006		
	% Yes Pretest (95% CI)	% Yes Posttest (95% CI)	OR of Improvement (95% CI)	% Yes Pretest (95% CI)	% Yes Posttest (95% CI)	OR of Improvement (95% CI)	% Yes Pretest (95% CI)	% Yes Posttest (95% CI)	OR of Improvement (95% CI)
Medication when well?	n/a	n/a	n/a	44.5 (37.3-51.8)	51.1 (43.7-58.4)	1.63 (1.08-2.88)	42.7 (34.2-51.3)	48.9 (40.2-57.5)	1.57 (0.8-3.7)
>1 ED/hospital visit?	95 42.1 (32.0-52.2)	24.2 (15.4-33.0)	3.13 (1.41-6.92)	27.5 (21.6-33.4)	12.2 (7.8-16.5)	3.83 (2.03-7.23)	28.2 (21.3-35.4)	16.7 (10.9-22.5)	2.36 (1.26-4.40)
>1 MD visit for asthma symptoms?	94 72.3 (63.1-81.6)	53.2 (42.9-63.5)	3.00 (1.41-6.39)	57.7 (51.1-64.3)	40.0 (33.5-46.5)	2.5 (1.59-3.93)	47.2 (39.5-55.0)	43.4 (35.9-51.3)	1.21 (0.74-2.00)

CI, confidence interval; ED, emergency department; MD, physician; n/a, not available.

symptoms, health care utilization, correct medication usage, positive asthma behaviors, and reduction in asthma morbidity for urban adolescent students during the first 3 years of the program's implementation. Days of activity limitations and mean night of sleep disruption were significantly reduced during 2 years of the program; mean days of school missed were significantly reduced by 0.5 day for 1 year of the intervention. Proportion of students who reported outpatient emergency care or hospitalization for asthma was significantly reduced from baseline to follow-up for all 3 years the program has been offered; decreases in physician visits for asthma-related symptoms were significantly lower after participation during the first 2 years of the program. Frequency of daytime symptoms declined for the first 3 years of the program; frequency of nighttime symptoms improved for the second 2 years of improvement, although this category was not significantly different from the "no change" category. Asthma device use (ie, spacers, peak flow meters) significantly improved for all years devices were distributed to students. Last, the majority of students demonstrated an improvement in overall asthma symptoms score after participation in the Kickin' Asthma program.

Results from previous studies on the impact of school-based asthma interventions, particularly in urban settings, have been mixed. Further, many of the studies evaluated have been implemented in elementary schools as opposed to secondary schools, limiting the direct comparability of our results.

Several recent studies have tested the effects of school-based asthma education on asthma morbidity among elementary school students using a cluster-randomized approach. Gerald et al³³ implemented a comprehensive asthma education program targeted to 3 separate groups (asthmatic students, general student body, and faculty and staff) in 54 elementary schools serving an urban, predominantly African American, community. The authors did not find any meaningful differences between pre- and posttest prevalence of school absences, grades, emergency department visits, and hospitalization for children with asthma after a participation in the program.³³ Implementation of the Open Airways for Schools curriculum among African American children in 8 urban schools resulted in no significant change in asthma-related school absences and asthma medication use between treatment and control groups as well, comparing pretest to posttest results in the intervention group.³⁴ The intervention group had a significant decrease in asthma symptoms postintervention as well as significant increase in urgent care visits postintervention.³⁴ Implementation of the Open Airways for Schools curriculum in 14 urban, predominantly African American, elementary schools resulted in a significant improvement in daytime symptoms postintervention for children in

Table 6. ORs for Change in Categorical Variables (Baseline = No Change)

	SY 2003-2004			SY 2004-2005			SY 2005-2006		
	Improved		Worsened	Improved		Worsened	Improved		Worsened
	n	n, OR (95% CI)	n, OR (95% CI)	n	n, OR (95% CI)	n, OR (95% CI)	n	n, OR (95% CI)	n, OR (95% CI)
Daytime symptoms, previous 4 weeks?	102	58, 1.92 (1.32-2.80)	24, 0.94 (0.63-1.42)	227	97, 2.13 (1.66-2.72)	70, 0.78 (0.61-1.00)	163	79, 2.30 (1.70-3.11)	45, 0.89 (0.64-1.23)
Daytime symptoms, previous 3 months?	20	10, 1.22 (0.62-2.42)	5, 0.72 (0.32-1.63)	229	120, 1.71 (1.35-2.17)	59, 0.75 (0.57-0.98)	163	79, 2.97 (2.10-4.21)	37, 0.92 (0.65-1.31)
Nighttime symptoms, previous 4 weeks?	110	30, 2.61 (1.64-4.16)	40, 1.00 (0.63-1.59)	226	93, 3.84 (2.51-5.89)	46, 0.65 (0.39-1.08)	164	70, 6.53 (3.4-12.5)	32, 1.62 (0.84-3.11)
Peak flow meter use?	104	42, 7.11 (2.56-19.76)	22, 0.08 (0.02-0.28)	216	99, 9.96 (5.01-19.84)	19, 0.08 (0.03-0.24)	153	29,* 1.80 (0.78-4.18)	30, 0.10 (0.04-0.26)
Spacer use?	102	24, 5.25 (1.98-13.94)	30, 0.20 (0.09-0.45)	225	85, 4.82 (2.76-8.42)	25, 0.11 (0.05-0.28)	158	36, 2.75 (1.43-5.27)	24, 0.30 (0.14-0.63)

CI, confidence interval.

*Peak flow meters were not distributed to students in class during SY 2005-2006.

the treatment group compared to the control group; however, children in the treatment group had an increase in report of nighttime symptoms postintervention compared to the control group.³⁵ However, the authors hypothesized that the increase in night symptoms resulted from an improved parental asthma knowledge. A randomized study of an in-school asthma education program for elementary school children in suburban Toronto resulted in a significant decrease in mean urgent care visits, asthma-related school absences, and activity restrictions for the intervention group compared to the control group.³⁶

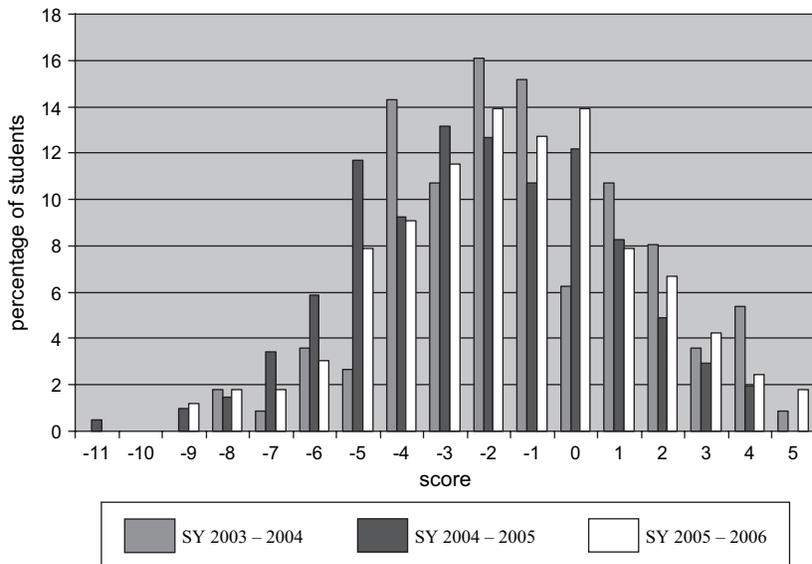
Two school-based asthma educational interventions that target specifically adolescents were found in the literature. *Power Breathing*, an in-school asthma education program designed specifically for adolescents, has been pilot tested among a small group of individuals and had found a decrease in asthma symptoms among participants.²⁶ Asthma Self-Management for Adolescents, specifically targeted to urban adolescents, has been pilot tested among a small group of students but has not at this time reported changes in asthma morbidity as a result of program participation.²⁷

There are several limitations to our analyses. First, asthma symptoms and management behaviors were only measured for students at 2 time intervals. Additional follow-up will be necessary to investigate if these positive and significant changes measured will be demonstrated longitudinally. Further, asthma-related outcomes were all self-reported. Although absentee data and health care utilization data could ostensibly be collected through other means, both human subject concerns and program logistics limited verification of these data.

Second, the medication question on the survey asked students if they used any asthma medications when they felt well (ie, no symptoms). Although this was interpreted as controller medication, it is likely that students may have reported the use of a rescue medication when feeling well. A future analysis will investigate patterns of medication use among children who have participated in the Kickin' Asthma program.

Third, rather than evaluate change in each symptom individually, a summary score of change was created to get a sense of the overall impact of the program on the child's health. However, the drawback of the summary score calculated is that each of the 11 questions evaluated as part of the score was given equal weight; in other words, a reduction in school absences was given the same score as a reduction in frequency of daytime symptoms for each student. For example, school absences may be a more important outcome measure compared to daytime symptoms; it is not clear that each symptom change deserves an equal weight. An omnibus measure of improvement may not be the most effective way to measure individual change.

Figure 1. Distribution of Baseline to Follow-Up Survey Change in Asthma Morbidity Scores for Kickin' Asthma Participants



Fourth, one of the most important aspects of an evaluation is an assessment of the needs and morbidity levels of the enrolled population compared to the eligible population. If the eligible population had a greater morbidity level, the intervention may not have adequately captured those students in most need of services. For example, for SYs 2004-2005 and 2005-2006, students who completed the follow-up survey had relatively fewer days with activity limitations and school absences compared to students who did not complete the series, respectively. Further, class attendance data from SY 2005-2006 indicate that students who did not complete the series were able to complete the 3-month follow-up survey. Missed classes may result in several of the nonsignificant differences found with regard to symptom and health care utilization data for that SY.

Finally, we did not include potential confounders in the evaluation of outcomes, such as sex of child, school characteristics, number of sessions attended, and time of year in the analysis. Time of year is particularly important since Kickin' Asthma sessions were offered throughout the SY. A student's frequency and severity of symptoms may change due to the seasonality of asthma, irrespective of the effect of the intervention. These confounders will be included in a future evaluation of the program effectiveness.

Implementation of a large-scale asthma intervention was not without challenges. With regard to program logistics, the designation of an in-school staff member to locate appropriate classroom space for sessions, help identify and locate students, as well as provide access to school facilities and equipment was invaluable. Further, the presence of ALA staff mem-

bers to assist with recruitment, logistics, and education during SY 2004-2005 was thought to result in the demonstrable increase in program enrollment for the second and third year of the intervention.

Motivating secondary school students to devote their only free time during the day to asthma education was often an issue. As demonstrated in Table 2, there was substantial attenuation between completion of the baseline survey and completion of the 3-month follow-up survey. Students in middle school and high school have several teachers throughout the day, which can make coordination more of a challenge. Further, elementary school children often do not question the voluntary nature of these programs: they will usually attend if offered the opportunity. On the other hand, older children, particularly teenagers, understand that such classes are optional. For a variety of reasons, they are more likely to choose not to attend.

Our evaluation indicates that a significantly greater proportion of eligible sixth graders enrolled in the program and significantly lower proportion of eligible eighth graders enrolled in the program. Although the target audience was initially students in sixth and ninth grades, it is clear that the program was more successful with regard to program recruitment and completion among younger students. It is not apparent if the lack of success of the program among older students was due to the age appropriateness of the materials or lack of time and/or interest on the part of the students.

Nonparticipation of many students after initial enrollment in Kickin' Asthma is a programmatic challenge. Although reasons for nonparticipation are not known, we hypothesize that many students may feel

that their asthma is not severe or problematic and does not warrant participation in an asthma education program. Further, the lack of incentives for SY 2005-2006 may have contributed to the low enrollment for the Kickin' Asthma series. To encourage students to attend the sessions, an incentive was reinstated for the 2006-2007 SY.

School-based education has several limitations with regard to comprehensive asthma management since many adolescents do not have the financial resources or decision-making authority with regard to health care. Thus, it is critical to provide follow-up support when the sessions end, as resources allow. Based on symptom and management data collected through the Kickin' Asthma program, some students receive referrals for clinical care or case management, especially students without insurance, with multiple acute care utilizations, or with medication behaviors that clearly differ from recognized practices. On occasion, the health educator will call the parent or guardian or health care provider by phone. A coordinated approach, which links the school with the students' home and health care providers, is perhaps the most comprehensive intervention available for students. Although students are taught problem-solving skills during the sessions, such as what to do if an adult is smoking inside the house, the implementation of these skills cannot be adequately assessed and measured. To address some of these issues, OKA also administers a home-based asthma education program specifically targeted toward family education and household asthma management. Future analyses will measure the effect of the home-based program and evaluate whether there is a synergistic effect of offering a simultaneous school-based and home-based asthma education program.

CONCLUSION

Our data indicated that a school-based educational program targeted to urban adolescents with asthma is associated with a significant reduction in asthma symptoms, emergency and unplanned health care utilization, school absences, and activity limitations and is positively associated with improved asthma management behaviors and use of prevention medication. Recruitment and retention of students proved to be the largest challenge to effective implementation of the Kickin' Asthma program. However, the development of a partnership with individual schools, as well as the introduction of creative recruitment techniques to encourage participation and completion of the program, was the foundation for the viability of the program. As urban adolescents are faced with various challenges related to their health and well-being, provision of health education resources in a school-

setting allows for broad access to asthma education with minimal disruption to the academic schedule.

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