Evaluation of the Fight Asthma Now (FAN) program to improve asthma knowledge in urban youth and teenagers

Giselle S. Mosnaim, MD, MS*; Hong Li, PhD*; Maureen Damitz, AE-C†; Lisa K. Sharp, PhD‡; Zhengyun Li, MS†; Ami Talati, MD§; Farheen Mirza, MD‖; DeJuran Richardson, PhD*¶; Gary Rachelefsky, MD#; Joel Africk, JD†; and Lynda H. Powell, PhD*

Background: School-based asthma education programs targeting disadvantaged youth and teens with asthma are lacking.

Objectives: To assess the impact of the Fight Asthma Now (FAN) educational program among 2 populations of predominantly low-income minority students: youth (3rd–6th graders) and teens (7th–8th graders).

Methods: Chicago-area elementary schools were invited to participate in this stratified 2-arm study. Eligible schools were assigned to participate either in the intervention or in the control arm. Within each participating school, eligible students were recruited and grouped (stratified by grade and age) to form teen or youth classes. Participants completed a pre- and post-intervention asthma knowledge questionnaire and observation for spacer technique competency. The treatment group received the FAN curriculum between the evaluations.

Results: A sample of 26 low-income, predominantly minority-serving schools was recruited. Most participating schools were randomized in a 3:1 ratio to form 25 youth classes (19 intervention and 6 control group) and 16 teen classes (11 intervention and 5 control group), resulting in 275 vs 69 youth and 141 vs 51 teens in the intervention and control groups, respectively. Stratified analyses were performed, and clustering within the school and class was taken into consideration in analyses. Multilevel models adjusting for school, class, ethnicity, sex, and pretest score indicate that the FAN intervention significantly increased both knowledge and spacer competency test scores, among both the youth and teen participants ($P = .011$ with respect to knowledge score among teen students, $P < .0001$ for all other cases).

Conclusions: This study suggests that FAN significantly increases asthma knowledge and spacer technique competency within this high-risk population.

Ann Allergy Asthma Immunol. 2011;107:310–316.

INTRODUCTION

Asthma is the most common chronic illness of childhood in the United States, with 9.1% of children (6.7 million) estimated to have current asthma.[1] Asthma is the leading cause of school absenteeism attributable to a chronic illness, with 12.8 million school days missed among the 4 million children reporting 1 or more asthma attacks in the prior year.[2] Low-income and minority children suffer from disproportionately high rates of asthma prevalence,[1] as well as asthma morbidity and mortality.[1–7] Compared with non-Hispanic white children, Puerto Rican children are 2.4 times more likely and non-Hispanic black children are 1.6 times more likely to have current asthma.[1] Non-Hispanic black children have an emergency department visit rate 4.1 times higher, asthma-related hospitalization rate 3.0 times higher, and a death rate 7.6 times higher than the rate for non-Hispanic white children.[1]

The school setting offers many advantages over the traditional clinic-based setting for delivering asthma education to disadvantaged minority children.[8–11] Schools are located within the community and offer wide community access. School-based asthma education programs may circumvent barriers related to transportation and access to health care providers.[12,13] Given the relationship between average daily attendance of students and school funding, improving students' asthma and reducing asthma-related school absenteeism is a priority for school administrators.

Several school-based asthma education programs for low-income minority children exist, including Open Airways for

Affiliations: * Department of Preventive Medicine, Rush Medical College, Chicago, Illinois; † Respiratory Health Association of Metropolitan Chicago, Chicago, Illinois; ‡ Department of Medicine, Section of Health Promotion Research, University of Illinois at Chicago, Chicago, Illinois; § Department of Immunology/Microbiology, Rush Medical College, Chicago, Illinois; ‖ Department of Internal Medicine, Rush Medical College, Chicago, Illinois; ¶ Department of Mathematics & Computer Science, Lake Forest College, Lake Forest, Illinois; # Department of Pediatrics, Geffen School of Medicine, University of California-Los Angeles, Los Angeles, California.

Disclosures: Dr. Mosnaim serves on the Scientific Advisory Board, owns stock options, and conducts research for Electrocore, LLC; she also served on a Scientifc Advisory Board for Medco. Dr. Rachelefsky serves as a consultant or receives honoraria from Merck & Co., Inc., Teva Pharmaceuticals USA, and Astra Zeneca Pharmaceuticals LP.

Funding Sources: This study was supported by an unrestricted educational grant from Abbott Laboratories.

Received for publication May 17, 2011; Received in revised form June 23, 2011; Accepted for publication July 20, 2011.

doi:10.1016/j.anai.2011.07.008

Schools,[14–16] Oakland Kicks Asthma (OKA),[11] and Power Breathing.[17] Each of these programs targets either elementary or secondary school-aged children. Open Airways for Schools, Oakland Kicks Asthma, and Power Breathing were designed for children in grades 3 through 5 (ages 8–11), 6 through 10 (ages 11–18), and 6 through 12 (ages 11–19), respectively.[11,14–17] Fight Asthma Now (FAN) is a new school-based asthma education program consisting of a FAN Youth Curriculum designed to meet the needs of 3rd through 6th graders (ages 8–12) as well as a FAN Teen Curriculum designed for 7th through 12th graders (ages 13–18). The FAN Youth and Teen Programs share common core asthma education topics and contain age-appropriate language and tailored components addressing tobacco and social pressures that are unique to each age group. The primary aim of this study was to evaluate the ability of the FAN Program to improve asthma knowledge and spacer technique among low-income minority youth and teens with asthma.

METHODS

Subjects and Recruitment

Participating elementary schools in the Chicago Public School and Southern Cook County School districts were recruited first, and then eligible students within the schools were contacted to solicit their participation. Schools were eligible if 70% or more of their students qualified for school lunch subsidy. A child was eligible for the subsidized school lunch program if his family's annual income was 1.85 times or less of the poverty line of $22,050 for a family of 4.[18]

Between September 2007 and August 2008, schools within these school systems received multiple invitations (by phone and facsimile) to participate. Participation required the school to recruit volunteers from their student body to form a youth class or teen class to represent their school within the study. Depending on the number of eligible student respondents, schools were allowed to form more than 1 Teen or Youth class. Written permission from the school's principal was required for school participation. On receipt of written consent from the principal, each school was randomized to either the FAN intervention or the control. The randomization was to be performed in a 3:1 ratio in blocks of 4 so that within each block, 3 schools would be randomized to the FAN intervention and 1 school to the control. The 3:1 randomization ratio would help ensure sufficient data to comprehensively assess the effectiveness of the FAN Program within this student population. Once assignment to intervention or control was accomplished, all students within the school were invited to participate by a take-home flyer distributed during homeroom. Students self-identified as having asthma and volunteered to participate in the FAN program through this take-home flyer. Written parental/guardian consent was required before students could participate in the FAN program.

The Rush University Medical Center and the University of Illinois at Chicago Institutional Review Boards, as well as the principal of each participating school, approved this study.

FAN Educators

Four FAN educators were recruited by the Respiratory Health Association of Metropolitan Chicago to deliver the FAN intervention within this study. These educators were selected from a pool of college-educated Americorp volunteers and had no prior health care or asthma training. Each educator participated in the same 1-day training session consisting of 3 hours of general asthma education followed by 4 hours of instruction on effective techniques for presenting the FAN Youth and Teen curriculums and administering the knowledge and spacer tests. The FAN educator training was conducted by a Certified Asthma Educator and overseen by an experienced FAN trainer from the Respiratory Health Association of Metropolitan Chicago. This FAN trainer accompanied the educators into each school and directly supervised the first FAN sessions. The trainer provided ongoing feedback and promoted consistency across the training.

FAN Educational Program

The FAN Program consisted of four 45-minute sessions conducted in the school on 4 consecutive school days. Sessions were scheduled at times with the least impact on instruction, as determined by the particular school.

Table 1 outlines the educational content developed through (1) research into existing asthma educational programs for youth and teens[11,14–17]; (2) focus groups with 140 youth and teens; and (3) feedback from an advisory panel that included pediatricians and nurses with a focus on asthma, respiratory therapists, Certified Asthma Educators, and parents of children with asthma. The educators provided "one-on-one" training for spacer technique, peak flow meter use, and use of an asthma action plan. The youth (3rd–6th grade) and teen (7th–12th grade) curriculums differed in language use and approach to tobacco avoidance and asthma-related peer pressure at home and at school. The teen program also addressed asthma self-management skills in future college or job settings.

Assessment Measures

Asthma knowledge and ability to perform proper spacer technique were assessed by using the absolute number of items correct on the FAN Asthma Knowledge Questionnaire and the FAN Spacer Competency Checklist.

These 2 assessments were performed within each class at designated pre- and post-intervention times. A panel that included a Certified Asthma Educator, a psychologist with expertise in asthma, and an allergist/immunologist with extensive clinical experience caring for low-income youth and teens with asthma developed these two instruments, building on existing asthma knowledge questionnaires and spacer competency checklists.[14–16,19]

At the designated time, the FAN Asthma Knowledge Questionnaire was administered to a FAN class by the edu-

Table 1. FAN Asthma Manual Educational Components[a] by Age Group

Component[a]	Youth	Teen
Pathophysiology	✓	✓
Trigger avoidance	✓	✓
Self-monitoring	✓	✓
Proper peak flow meter use[b]	✓	✓
Asthma action plan use[b]	✓	✓
Appropriate use of medications	✓	✓
Quick-relief	✓	✓
Controller	✓	✓
Spacer technique[b]	✓	✓
Exacerbation warning signs	✓	✓
Tobacco[a]	Facts about smoking	The truth about tobacco
Social barriers to proper care[a]	Asthma challenges at home and school	Life social pressures and your health Managing your asthma at college or on the job

[a] Most FAN components were taught in the same way in the youth and teen manuals, but tobacco avoidance and social barriers to proper care were tailored to meet the needs of the two different age groups.
[b] Additional one-on-one instruction provided on proper peak flow meter use, asthma action plan use, and spacer technique.

cator, who read each item aloud and had each student individually record their response. The FAN Asthma Knowledge Questionnaire consisted of 15 "Yes/No" items addressing the instructional topics. All items were equally weighted and scored as correct or incorrect (range, 0–15 items correct). A FAN educator observed and scored each student's spacer technique before and after the intervention, using the 8-item FAN Spacer Checklist. All items were equally weighted and scored as correct or incorrect (range, 0–8 items correct). The FAN asthma knowledge and spacer technique pretests and posttests were administered to each class 4 days apart. The FAN intervention group received the 4 education sessions between pretesting and posttesting.

Statistical Analyses

This study employed a stratified (youth vs teen), 2-arm, clustered (by school), 3:1 randomized design. However, because of school scheduling conflicts, the fully randomized design was modified slightly to accommodate these practical difficulties. The allocation scheme first determined whether an eligible school could accommodate the intervention schedule. Those that could not were automatically assigned to the control group, whereas those that could were subject to the 3:1 randomization scheme. Within each school (cluster), students were recruited and stratified into youth or teen classes according to their grade level. Schools were allowed to form multiple classes within each grade level, depending on the number of participating students. Thus, individual students were stratified by youth vs teen and clustered within class and school. Statistical procedures were employed that provided effective analyses of data obtained from such a multilevel study design.[20]

Baseline demographic and assessment variables were compared between treatment groups within strata, to assess balance. The cluster-adjusted *t*-test or Wilcoxon rank sum test[21] was used, depending on the appropriateness of the normality assumption, to compare continuous variables (age and test scores). Discrete variables (sex and ethnicity) were compared using the cluster-adjusted χ^2.[20] These cluster-adjusted test procedures produce results similar to their unadjusted counterparts when the cluster effect is not statistically significant. The primary outcome measures for each student were posttest score and change (posttest minus pretest) in score. These outcomes were compared between groups as continuous variables using the cluster-adjusted *t*-test or Wilcoxon rank-sum test, as appropriate.

Multilevel, or hierarchical, modeling[20] was used to assess the influence of school, class within school, treatment group, and other prespecified covariates (pretest score, ethnicity, and sex) on the posttest score. Significance of school and class within school as different levels within the model are determined via separate calculation using model parameters.[22] For these models, posttest score was the dependent variable, and the independent variables were treatment group, pretest score, ethnicity, and sex. Pretest score, ethnicity, and sex were considered fixed effects, and treatment group was considered a random effect. Data imputation methods were considered to address missing data encountered with respect to posttest measures. All statistical analyses were performed using SAS 9.2 software (SAS Institute, Cary, North Carolina).

RESULTS

Recruitment and Demographics

Table 2 lists the 26 schools that participated in this study: 18 Chicago Public Schools and 8 Southern Cook County Schools. From these schools, a total of 25 Youth classes (19 intervention vs 6 control) and 16 Teen classes (11 intervention vs 5 control) were recruited. Three schools recruited more than 1 class within a given stratum. Each class contained 4 to 30 student participants. Altogether, a total of 344 students participated within the youth strata (275 within the FAN intervention and 69 in the control group) and 192 within

Table 2. Enrolled Schools and Number of Students Participating at Each School

Youth		Teenagers	
Intervention	**Control**	**Intervention**	**Control**
#1[a] (5)	#16[a] (14)	#1[a] (4)	#17[a] (11)
#2[a] (27)	#17[a] (29)	#3[a] (13)	#18[a] (4)
#3[a] (17)	#18[a] (11)	#4[a] (9)	#9[a] (14)
#4[a] (19)	#19[b] (10)	#6[b] (11)	#25[a] (11)
#5[b] (12)	#9[a] (1)	#13[b] (19)	#26[a] (11)
#6[b] (11)	#20[a] (4)	#21[a] (14)	
#7[b] (14)		#22[a] (8)	
#8[a] (20)		#23[a,c] (42)	
#9[a] (23)		#24[a] (18)	
#10[a] (17)		#15[a] (3)	
#11[b,c] (53)			
#12[b] (16)			
#13[b,c] (24)			
#14[b] (10)			
#15[a] (7)			

[a] These schools are Chicago Public Schools.
[b] These schools are Southern Cook County Schools.
[c] These schools recruited more than one class within a given strata. School 11 recruited 4, and School 13 recruited 2 youth classes. School 23 recruited 2 Teen classes.

the teen strata (141 in the intervention and 51 in the control group).

Table 3 presents baseline demographics. The cluster-adjusted Wilcoxon rank-sum test was used to compare baseline age between the 2 treatment groups, because nonnormality of the data was evident. Median age at enrollment for the treatment and control group participants were similar (youth = 10; teen = 13). Within both strata, a significant difference was seen between the treatment and control groups with respect to sex ($P = .011$ and $P = .026$ for the youth and the teen strata, respectively), and ethnicity ($P < .0001$ within both the youth and the teen strata). Most subjects in the treatment and control groups self-identified as either African-American or Hispanic (77% vs 92.8% in the youth stratum and 92.2% vs 90.2% in the teen stratum).

Effect of FAN Program on Asthma Knowledge and Spacer Use

Unadjusted analyses comparing the study's primary outcomes (measures of asthma knowledge and effective spacer use) are presented in Table 4. Approximately 15% of the participants overall were missing posttest scores (39 youth and 44 teen participants). Whereas the missing data were reasonably balanced within the youth stratum (35 in the intervention group vs 5 in the control group), it was unbalanced within the teen stratum (39 in the intervention group vs 5 in the control group). Most of these missing values resulted from participants specifically not showing up on the posttesting day. Based on feedback from our trained educators as to the source of the absenteeism, we concluded that these missing data were missing at random and did not merit use of data imputation methods.

Asthma Knowledge Questionnaire

No significant difference was seen between the 2 groups with respect to pretest scores within the youth or the teen strata ($P > .6$ in both cases). In addition, no significant difference was found between the 2 groups with respect to posttest scores ($P = .136$ within the youth stratum and $P = .282$ within the teen stratum). Within the intervention group, the median change score (posttest score minus pretest score) was 2 points and 1 point for the youth and teen strata, respectively. Within the control group, the median change score was 0 for both strata. Within both strata, the change in test scores (from pretest to posttest) was not significantly different between the treatment and control groups.

Spacer Competency Checklist

No significant difference was found between the 2 groups with respect to the pretest scores within the youth or the teen strata ($P = .189$ within the youth strata and $P = .159$ within the teen strata). A significant difference was found between

Table 3. Demographic Characteristics for Youth and Teenagers

Characteristic	Youth			Teenagers		
	Intervention (*N* = 275)	**Control (*N* = 69)**	***P***	**Intervention (*N* = 141)**	**Control (*N* = 51)**	***P***
Age						
Median (range)	10 (8–13)	10 (8–13)	.247	13 (12–15)	13 (12–15)	.784
Sex						
N (%)						
Female	114 (41.5)	33 (47.8)	.011	68 (48.2)	18 (35.3)	.026
Male	159 (57.8)	36 (52.1)		72 (51.1)	33 (64.7)	
Race/ethnicity						
N (%)						
African-American	180 (65.5)	45 (65.2)	<.0001	120 (85.1)	32 (62.7)	<.0001
Hispanic	32 (11.6)	19 (27.5)		10 (7.1)	14 (27.5)	
Other	61 (22.3)	5 (7.3)		10 (7.1)	5 (9.8)	

Table 4. Unadjusted Analyses of Asthma Knowledge and Spacer Competency Scores for Youth and Teenagers

Characteristic	Youth			Teenagers		
	Intervention (*N* = 275)	Control (*N* = 69)	*P*	Intervention (*N* = 141)	Control (*N* = 51)	*P*
Asthma Knowledge Score Median (range)						
Pretest	11 (6–14)	9.5 (1–15)	.668	11 (1–14)	10 (4–14)	.735
Posttest	12 (7–14)	12 (7–14)	.136	12 (2–13)	11 (5–14)	.282
Difference	2 (−3–7)	0 (−6–4)	.37	1 (−4–4)	0 (−5–3)	.184
Spacer Competency Score Median (Range)						
Pretest	0 (0–8)	0 (0–7)	.189	0 (0–7)	0 (0–6)	.159
Posttest	7 (0–8)	2 (0–7)	.049	7 (5–8)	4 (0–7)	.179
Difference	4 (−2–8)	0 (−4–6)	.052	5 (−1–8)	0 (−2–6)	.16

the treatment and control groups with respect to the posttest scores among the youth ($P = .049$), but not among the teens ($P = .179$). The median change score was approximately 4 points in the intervention group for both age groups. The change scores were marginally different between the treatment and control groups among the youth ($P = .052$), but not among the teen participants ($P = .16$).

Multilevel Modeling

Results from the multilevel modeling are presented in Table 5, in which parameter estimates are presented along with associated *P* values for significance. Parameter estimates are presented only for covariates whose *P* value was less than or equal to .20. Among the schools that recruited more than 1 class within a stratum, analyses indicated that class affiliation within the school was not a significant factor ($P > .40$ within both youth and teen strata, for both types of test), although school affiliation was a reasonably significant contributor to the model ($P < 0.01$ within the youth stratum and $P = .06$—for both tests—within the teen stratum). Pretest baseline score and sex were significant predictors for posttest asthma knowledge score among teens. Within the 3 other models presented, pretest score is the only significant predictor. The models indicate that, after adjusting for school, class, pretest score, ethnicity, and sex, the average knowledge posttest score within the intervention group was 2.14 points ($P < .0001$) and 0.85 points ($P = .011$) higher than the average control group score among the youth and teen participants, respectively. The average spacer competency posttest scores in the intervention group was 3.77 points ($P < .0001$) and 3.94 points ($P < .0001$) higher than the average control group score among the youth and teen participants, respectively. Among the teen participants, asthma knowledge posttest scores among females were 0.52 points higher on average than those among the males ($P = .028$).

DISCUSSION

The FAN program demonstrated improvements in asthma knowledge and spacer technique among low-income minority youth and teens—a group known to have rates of asthma prevalence, morbidity, and mortality that are among the highest in the United States.[1–7]

The impact of asthma on this population is not surprising, because low-income minority children do not receive the same quality of health care and are less likely to be prescribed preventive asthma medications.[5,23–25] Additional barriers may include lack of health insurance, difficulty getting to a physician, fear of doctors and medicine, and other cultural attitudes toward disease and treatment.[26,27] Thus, rather than relying on the conventional health care model of in-office education, the investigators sought to develop a large-scale yet feasible asthma education program that would reach these children in public schools in their communities and would be offered as part of their daily school routines.

The FAN program distinguishes itself from other school-based asthma education interventions in 2 dimensions: it addresses the educational, tobacco avoidance, and unique social asthma self-management needs of both 3rd through 6th and 7th through 12th graders with asthma; and it has a proven

Table 5. Asthma Knowledge and Spacer Competency Scores for Youth and Teenagers Using Multilevel Modeling

Variables	Youth		Teenagers	
	Coefficient	*P*	Coefficient	*P*
Asthma Knowledge Score				
Intervention	2.14	<.0001	0.85	.011
Baseline Score	0.44	<.0001	0.61	<.0001
Spacer Competency Score				
Intervention	3.77	<.0001	3.94	<.0001
Baseline score	0.25	<.0001	0.26	<.0001

track record of being feasibly delivered to thousands of low-income minority children. In the 2007/2008, 2008/2009, and 2009/2010 school years, 1,586, 1,496, and 1,046 children in the Chicago area received the FAN program, respectively, and other states, including California and Arkansas, have requested to use the FAN curriculum. The promising feasibility of implementing the FAN program may be attributed to cost containment. All supplies, materials, and staff time cost $38.93 per child, given that it is taught by lay health educators rather than health care providers. Moreover, it easily fit into existing school schedules, with minimal disruption of educational time or use of school personnel/resources. Finally, it features age- and culturally appropriate asthma educational materials.

This study was not without limitations. Every attempt was made to follow the original 3:1 randomization design. However, structural constraints prevented some of the schools from accommodating the educators' availability to provide the FAN program, and thus we adopted the semi-randomized group allocation scheme, as described.

An imbalance of sex and ethnicity was found between the intervention and control groups, for both youth and teen strata. This may partially explain why the unadjusted comparisons between treatment groups in Table 4 are mostly insignificant, whereas the multivariate and adjusted analyses in Table 5 indicate that treatment is superior to the control in increasing test scores. Although we concluded that missing data were missing at random, this was proportionally unbalanced within the teen stratum, with almost 30% of the post-test scores missing within the intervention group. This is somewhat understandable given the rigors of the intervention. Data imputation methods and the associated assumptions appeared untenable here; however, such a level of missing data merits concern.

Although the FAN educational program was able to consistently show improvements in asthma knowledge and spacer technique, no guidelines exist as to whether these changes are clinically significant. The study did not measure whether these improvements translated into changes in important outcomes such as missed school days or emergency room visits attributable to asthma. These outcomes require additional resources and were beyond the scope of this study. However, given the findings reported here, future evaluations should include these important clinical outcomes.

Finally, the sustainability of these effects is unknown. Questions remain as to whether the students will retain the asthma knowledge and spacer competency skills learned and how often reinforcement education should be provided. These questions should be included in future studies focusing on the FAN intervention.

In conclusion, in this stratified, clustered, 2-arm study, FAN improved asthma knowledge and spacer technique in a high-risk group of youth and teens. These results suggest that this school-based program is a feasible way to deliver effective asthma education to children who may not otherwise have access to these services.

REFERENCES

1. Akinbami LJ, Moorman JE, Garbe PL, Sondik EJ. Status of childhood asthma in the United States, 1980-2007. *Pediatrics.* 2009;123: S131–S145.
2. Akinbami LJ. The state of childhood asthma, United States,1980-2005. Advance data from vital and health statistics; no. 381, Hyattsville, MD: National Center for Health Statistics; 2006.
3. Akinbami LJ, Schoendorf KC. Trends in childhood asthma: prevalence, health care utilization, and mortality. *Pediatrics.* 2002;110: 315–322.
4. Gupta RS, Carrion-Carire V, Weiss KB. The widening black/white gap in asthma hospitalizations and mortality. *J Allergy Clin Immunol.* 2006; 117:351–358.
5. Halterman JS, Aligne CA, Auinger P, McBride JT, Szilagyi PG. Inadequate therapy for asthma among children in the United States. *Pediatrics.* 2000;105:272–276.
6. Grant EN, Wagner R, Weiss KB. Observations on emerging patterns of asthma in our society. *J Allergy Clin Immunol.* 1999;104: S1–S9.
7. Schwartz J, Gold D, Dockery DW, Weiss ST, Speizer FE. Predictors of asthma and persistent wheeze in a national sample of children in the United States: Association with social class, perinatal events, and race. *Am Rev Respir Dis.* 1990;142:555–562.
8. Anderson ME, Freas MR, Wallace AS, Kempe A, Gelfand EW, Liu AH. Successful school-based intervention for inner-city children with persistent asthma. *J Asthma.* 2004;41:445–453.
9. Christiansen SC, Zuraw BL. Serving the underserved: school-based asthma intervention programs. *J Asthma.* 2002;39:463–472.
10. Bartholomew LK, Sockrider MM, Abramson SL, et al. Partners in school asthma management: evaluation of a self-management program for children with asthma. *J Sch Health.* 2006;76:283–290.
11. Magzamen S, Patel B, Davis A, Edelstein J, Tager IB. Kickin' asthma: school-based asthma education in an urban community. *J Sch Health.* 2008;78:655–665.
12. Horner SD, Fouladi RT. Improvement of rural children's asthma self-management by lay health educators. *J Sch Health.* 2008;78:506–513.
13. Cicutto L, Murphy S, Coutts D, et al. Breaking the access barrier: evaluating an asthma center's efforts to provide education to children with asthma in schools. *Chest.* 2005;128:1928–1935.
14. Evans D, Clark NM, Feldman CH, et al. A school health education program for children with asthma aged 8-11 years. *Health Educ Behav.* 1987;14:267–279.
15. Bruzzese JM, Markman LB, Appel D, Webber M. An evaluation of Open Airways for Schools: Using college students as instructors. *J Asthma.* 2001;38:337–342.
16. Clark NM, Brown R, Joseph CLM, et al. Effects of a comprehensive school-based asthma program on symptoms, parent management, grades, and absenteeism. *Chest.* 2004;125:1674–1679.
17. Berg J, Tichacek MJ, Theodorakis R. Evaluation of an educational program for adolescents with asthma. *J Sch Nurs.* 2004;20:29–35.
18. Child nutrition programs: National school lunch program. United States Department of Agriculture Economic Research Service Web site. Available at http://ers.usda.gov/Briefing/ChildNutrition/Lunch.htm. Accessed August 3, 2010.
19. The American College of Chest Physicians Patient Education Guide: using your MDI with a spacer. American College of Chest Physicians Web site. Available at http://www.chestnet.org/downloads/patients/guides/inhaledDevices/patientEducation8.pdf. Accessed November 29, 2010.
20. Donner A, Klar N. Analysis quantitative outcome. In: *Design and Analysis of Cluster Randomization Trials in Health Research*. Atrium, United Kingdom: John Wiley & Sons, Ltd; 2000:111–127.
21. Rosner B, Glynn RJ, Lee M-LT. Incorporation of clustering effects for the Wilcoxon Rank Sum Test: a large-sample approach. *Biometrics.* 2003;59:1089–1098.

22. Singer JD. Using SAS Proc Mixed to fit multilevel models, hierarchical models, and individual growth models. *J Educ Behav Stat.* 1998;24: 323–355.
23. Akinbami LJ, LaFleur BJ, Schoendorf KC. Racial and income disparities in childhood asthma in the United States. *Ambul Pediatr.* 2002;2: 382–387.
24. Finklestein JA, Lozano P, Farber HJ, Miroshnik I, Lieu TA. Underuse of controller medications among Medicaid-insured children with asthma. *Arch Pediatr Adolesc Med.* 2002;156:562–567.
25. Lieu TA, Lozano P, Finklestein JA, et al. Racial/ethnic variation in asthma status and management practices among children in managed Medicaid. *Pediatrics.* 2002;109:857–865.
26. Flores G, Vega LR. Barriers to health care access for Latino children: a review. *Fam Med.* 1998;30:196–205.
27. Flores G, Tomany-Korman SC. Racial and ethnic disparities in medical and dental health, access to care, and use of services in US children. *Pediatrics.* 2008;121:286–298.

Requests for reprints should be sent to:
Giselle Mosnaim, MD, MS
Department of Preventive Medicine
Rush Medical College
1700 West Van Buren, Suite 470
Chicago, IL 60612
E-mail: gmosnaim@rush.edu