Asthma Status and Severity Affects Missed School Days

Sheniz A. Moonie, David A. Sterling, Larry Figgs, Mario Castro

ABSTRACT: *Excessive school absence disrupts learning and is a strong predictor of premature school dropout. School-aged children with asthma are absent more often compared to their healthy peers without asthma; yet, the causes are inadequately documented. We sought to determine the difference in mean absence days between children with and without asthma, the relationship between asthma severity and missed days from school, and if incident absences were due to asthma in a predominantly African American urban school district in the Midwestern United States. A cross-sectional analysis was conducted of 9014 students (grades K-12) followed for absenteeism over the 2002-2003 academic year. A subset of 543 students with asthma was assessed for asthma severity and cause of absence. Those with asthma (9.7% of students) were absent (mean = 9.2 days) approximately 1.5 more days compared to those without asthma (mean = 7.9 days) (p = .006). In the analysis comparing asthma severity and absenteeism, after adjusting for demographic variables and enrollment time, mean days absent increased with increasing asthma severity level: mild intermittent (mean = 8.5 days), mild persistent (mean = 11.3 days), moderate persistent (mean = 10.3 days), and severe persistent (mean = 11.6 days) (p = .001). Out of 1537 tracked absences that resulted from illness, 478 (31%) were due specifically to asthma-related symptoms. Children with asthma are absent from school more often compared to their healthy peers and this appears to be driven by the underlying severity of symptoms.* (J Sch Health. 2006;76(1):18-24)

Asthma is the most common chronic childhood illness affecting approximately 6.3 million (8.7%) children in the United States.[1] Despite advances in our understanding of asthma's pathophysiology, there have been increases in the prevalence, morbidity, and mortality of children with asthma during the prior 2 decades.[2,3] Since 1980, the prevalence of asthma has increased by 75%.[2] Asthma accounts for more school absenteeism than any other chronic disease, and 60% of students with asthma miss school annually due to respiratory symptoms.[4,5] Prolonged absence or multiple brief absences from school may contribute significantly to negative school performance.[6] Children with chronic health impairments are often confronted with educational difficulties and disruption resulting from excessive and frequent absences.[7]

Increased absenteeism interrupts learning processes and interferes with the child's peer acceptance and participation in extracurricular activities.[8,9] Students who are absent must compensate for potential educational disadvantages such as makeup assignments and home or hospital-based educational services.[10] Several investigators have observed negative correlations between all-cause absenteeism or absence due to illness and academic performance.[11,12] The number of average annual school absence days due to asthma has increased from 6.6 million days in 1980 to 14 million days in 1996.[2] Up to 35% of school absences have now been attributed to asthma-related symptoms among school-aged children with an average of 20 days per school year lost,[13] and children with asthma are absent more often compared to their nonasthma peers.[14,15]

***Sheniz A. Moonie, MS**, Chronic Disease Epidemiologist, (sheniz@cs.com), Clark County Health District, Office of Epidemiology, PO Box 3902, Las Vegas, NV 89127; **David A. Sterling, PhD**, Associate Professor, (sterling@slu.edu), Division of Environmental and Occupational Health; and **Larry Figgs, PhD, MPH**, Associate Professor, (figgslw@slu.edu), Division of Epidemiology, Saint Louis University, School of Public Health, 3545 Lafayette Ave, St. Louis, MO 63104; and **Mario Castro, MD, MPH**, Associate Professor of Medicine, (castrom@im.wustl.edu), Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine and Pediatrics, Washington University School of Medicine, 660 S. Euclid Ave, St. Louis, MO 63110-1093.* *Supported in part by Grant/Cooperative Agreement Number U59/ CCU723263 from the Centers for Disease Control and Prevention (CDC). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.*

There is limited evidence that urban children with asthma are absent more often than children living elsewhere.[11] Studies focused on how asthma severity affects absenteeism, and the relationship between asthma and absenteeism among racial minorities residing in urban locations are limited. Since asthma is more prevalent among school-aged African Americans, it may be associated with educational achievement gaps since children with asthma miss more school days.[14] As a component of the planning process and to obtain baseline measures prior to the implementation of a school-based program to improve health services related to asthma we evaluated asthma status, asthma severity, and school absenteeism in a predominantly African American school district. We sought to determine (1) the difference in mean absence days between children with and without asthma, (2) the relationship between asthma severity and school absence, and (3) if incident absences were due to asthma symptoms.

METHODS

Data from a predominantly African American[16] school district located in the greater Saint Louis (Missouri) Metropolitan region was obtained during the 2002-2003 school year. District-wide data were available for all students within all schools for a cross-sectional comparison of asthma status and absenteeism. An analysis was performed among a smaller group of these students to evaluate causal determinants of absenteeism among students with asthma. All components of the study were approved by the Saint Louis University Institutional Review Board, the School District administration, and met all Health Insurance Portability and Accountability Act (United States Public Law 104-191) regulations.

Study Design

Asthma Status Ascertainment. The nurse in each school identified students as having asthma at the time they enrolled in school and throughout the school year in one of the following ways: (1) report by a parent/guardian to the nurse indicating the student has asthma, such as a phone call or signed note; (2) asthma medications (eg, albuterol) were supplied to the school nurse for administration or student self-administration with a physician's order;

(3) an asthma action plan was submitted; and (4) the students school health intake form indicated "asthma" as one of the preexisting health conditions. A clinical evaluation for asthma was not performed. All students not meeting the above criteria were considered as not having asthma. Asthma assessment using school health records has been shown to be a reliable method of tracking disease.[17]

Study Population

The study population was composed of all students (N = 9014) registered in the school district at anytime during the 2002-2003 academic year. Data included gender, age, race, school days enrolled, dates absent, type of absence, and the presence of asthma. From this population (all schools), 874 (9.7%) students were identified with asthma.

To evaluate absences specifically due to asthma and the relationship with asthma severity, a subset of students with asthma were assessed for symptom severity and prospectively tracked to determine reasons for absenteeism during the school year. Two schools did not participate in this subset: one elementary school did not have a full-time nurse during the study period, and a middle school (grades 7-8) declined participation due to perceived staff time constraints. There was no difference in the proportion of children with asthma in these 2 schools in comparison with those that did participate.

During the first month of the school year, a consent letter was provided to the parent/guardian of students with asthma through each participating school, to return *only* if they chose to decline their child's participation in the collection of this information throughout the school year. There were 770 students identified with asthma in the participating schools. Forms were returned to 227 students resulting in 543 students with asthma participating in the subset evaluating absences specifically due to asthma. Prospective tracking of absenteeism was performed daily from November 2002 through June 2003. Within 1 week of a student's recorded absence, the nurse met with the student to determine and document if the absence was due to symptoms likely related to asthma, or other medical illness by asking: (1) "Were you absent because you were ill?" and if yes to the first question (2) "Were you absent because of your asthma symptoms?"

Asthma symptom severity was assessed during the first 2 months of school through a form provided by the nurse to all participating students with asthma in grades 5-12 to complete while at school. It was determined by the nurses that children in grades K-4 would have a difficult time completing the form themselves, and the forms were sent home for completion with the parent or caregiver. The Asthma Symptomology form is based on the National Asthma Education and Prevention Program guidelines developed by the National Institutes of Health[18] and contains questions regarding the frequency of asthma symptoms such as shortness of breath, cough, wheeze, and sleep disturbances in the previous month. The asthma symptom severity for these students was determined using the response to these questions as mild intermittent, mild persistent, moderate persistent, or severe persistent. Out of those 543 students, 353 (65%) students were assessed for asthma severity using an Asthma Symptomology form. The completion rate of the symptom assessment form was 41% for grades K-4 and 80% for the students in grades 5-12.

Statistical Analysis

Analyses were conducted using SAS v.9.0 (SAS Institute, Cary, NC). Personal identifiers were removed prior to analyses to retain anonymity of study participants. The relationship between presence of asthma and days absent from school was analyzed using analysis of variance (ANOVA) (PROC GLM in SAS).[19] Identification and removal of extreme observations (above 99th percentile for both asthma and nonasthma groups) was performed using PROC UNIVARIATE along with visual detection of boxplots. ANOVA was used to determine differences in mean days absent between those groups of differing asthma severity level. *Post hoc* analysis employing the least significant difference (LSD) method was used to determine significant group differences.

RESULTS

Asthma Versus Nonasthma Absenteeism

The population was predominantly African American (94%) and of a low socioeconomic status (SES): 33% were below 185% of the US federal poverty level,[20] and 72.1% qualified for reduced or free lunch.[21] Prevalence of asthma by grade level, race, and gender is shown in Table 1. Of the 874 (9.7%) students reported as having asthma, prevalence differed significantly by grade level, race, and gender ($p < .05$) and decreased from 11.3% in elementary school to 7% in high school ($p < .0001$). The rate of asthma was 2-fold greater for African Americans (10%) compared with white students (5.2%) ($p < .0001$). Males (10.3%) were more likely to have asthma compared to females (9%) ($p = .01$).

Table 2 summarizes a multivariate model used to assess the relationship between absenteeism and asthma status, adjusting for number of days enrolled, race, and grade level. Analytic variables included academic grade level as elementary, middle or high school, race, and the number of student days enrolled. Univariate analysis revealed asthma status, race, and grade to be significant predictors of absenteeism ($p < .05$). Gender and school attended had no influence on days absent ($p > .05$), and therefore, these covariates were left out of developed models. Since the analysis demonstrated multicollinearity between age and grade level, age was not adjusted for in the analysis.[22] Overall, those with asthma missed 1.3 days more per school year compared to those without asthma ($p = .006$). Females with asthma missed approximately 1.5 days more on average compared to females without asthma ($p = .002$). African American students with asthma missed more days per school year (mean = 9.1 days) compared to African American students without asthma (mean = 8.0 days) ($p = .003$). White students with asthma (mean = 10.2 days) missed 2.1 more days of school per year compared to white students without asthma (mean = 8.1 days) ($p = .24$). Children with asthma in elementary school missed approximately one more day of school on average compared to the nonasthma students ($p = .006$). Children with asthma in middle school (mean = 11.2 days) missed approximately 3 more days compared to those without asthma (mean = 8.6 days) ($p = .006$).

Association of Absenteeism and Asthma Severity

A total of 3408 absences (N = 543 students) were captured for tracking to determine the reason for absence (Figure 1). Out of 3408 absences, 1537 (45%) were due to illness (including asthma), 1554 (46%) were not due to illness, and 317 (9%) of the absences were students who were not sure if due to asthma or the data were missing. Of the 1537 absences due to illness, 478 (31%) were specifically due to asthma-related symptoms.

School nurses were able to capture 353 (65%) of the eligible 543 asthma students for symptom severity level assessment. Responses indicated that at the time of completion of the Asthma Symptomology form, 120 (34%) of the students had mild intermittent asthma, 96 (27%) had mild persistent asthma, 56 (16%) had moderate persistent asthma, and 81 (23%) had severe persistent asthma. Absenteeism was highly skewed to the left, and therefore was log transformed to achieve a normal distribution. Normality was demonstrated both graphically and by the skewness and kurtosis of the data after transformation. In the multivariate model adjusting for demographic variables and days enrolled, it was evident that as asthma severity increased, so did mean days absent from school ($p = .007$) (Figure 2). *Post hoc* LSD analysis yielded a significant difference in mean days absent between the mild intermittent group (mean = 8.5 days) with the mild persistent (mean = 11.3 days) and severe persistent groups (mean = 11.6 days) ($p < .05$).

Trends of Absenteeism

Absence rates for all district students (N = 9014) were plotted for every 2 weeks of the study period to determine if those with asthma were absent more often at different time points throughout the year (Figure 3). While there were no significant differences in absenteeism during any given 2-week time interval, those with asthma consistently (N = 874) had a higher absentee rate throughout the year compared with the nonasthma group (N = 8140). Additionally, out of the illness absences that were tracked (N = 543), peaks of absence due to asthma appeared in the colder months, especially November, February, and March.

DISCUSSION

The prevalence of asthma (9.7% overall) in our population of grade school and high school children is higher than the national self-reported average of 8.7%.[1] This is likely due to the fact that the prevalence of asthma is highest among African Americans, the predominant race of our study group. Asthma is more common among children of low socioeconomic and minority status,[23] and among those residing in economically disadvantaged inner-city populations,[5,8] such as the school district studied. Additionally, asthma is more prevalent among young children, and 60% of our population was enrolled in elementary school. Several studies have shown that asthma prevalence, hospitalization, and mortality are substantially higher among those of African American race compared to whites.[24,25] In a similar fashion, we found the asthma prevalence among whites was almost one half (5.2%) that of African Americans (10%). In the Third National Health and Nutrition Examination Survey, the highest risk subgroups for increased asthma prevalence were children who were 10 years or younger and of African American ethnicity.[26] Large urban areas have been shown to have consistently elevated asthma mortality rates.[27]

Table 1
Demographics and Frequency Distribution Between Asthma and Nonasthma Groups for Total District School Student Population (Entire District—All Schools)

	Asthma Status			
	Yes		No	
	N (%)*	p‡	N (%)*	p‡
Total school population 9014 (100)	874 (9.7)		8140 (90.3)	
School level†				
Elementary 5363 (59)	606 (11.3)	<.0001	4757 (88.7)	<.0001
Middle 1700 (19)	132 (7.8)		1568 (92.2)	
High 1951 (22)	136 (7.0)		1815 (93)	
Race§				
African American 8447 (94)	846 (10)	<.0001	7601 (90)	<.0001
White 523 (6)	27 (5.2)		496 (94.8)	
Gender				
Male 4598 (51)	475 (10.3)	.01	4123 (89.7)	.24
Female 4416 (49)	399 (9.0)		4017 (91)	

* Represents column percentages.
† Represents row percentages.
‡ Chi-square test for equal proportions for asthma prevalence.
§ N does not equal total population due to missing race (other) for 44 (0.5%) of the students.

One study assessing asthma mortality reported that neighborhoods of low SES and high minority representation are at disparately high risk for adverse asthma outcomes.[25]

While other studies support our findings that children with asthma have more school absenteeism,[4,15] few have incorporated minority groups into their studies. A recent case-control study found that children with asthma had 2.21 more days absent than those without asthma.[15] A UK study reported that among children with physician-diagnosed asthma, 348 (6%) missed more than 5 days per year while 43 (1%) children missed more than 20 days per year,[4] while a cross-sectional study demonstrated that children with asthma averaged 7.6 school days absent compared with 2.5 days in the well group.[12] A study among families with chronic health conditions reported that mean absent days among those with asthma were 16 compared with the state average of less than 7.[28] However, all of these studies targeted affluent and educated white populations, failing to incorporate subjects residing in urban areas.

A few studies have assessed school absenteeism among minority populations. A randomized controlled study measuring the impact of an educational intervention on grades and absenteeism in low-income neighborhoods found that the intervention group reported fewer absences attributable to asthma in the previous 3 months and at 1 year.[29] However, the study did not provide baseline data for the comparison of asthma versus nonasthma absenteeism. Another study conducted in minority schools found significantly higher asthma prevalence among those students who were absent greater than 25 days per school year compared to those with low absenteeism.[5] However, a direct comparison of mean school days absent between the asthma and nonasthma students was not included. Another minority study assessing the relationship between school attendance and language spoken at home with various academic measures found that students who had above-median attendance scored better on their standardized tests and had higher report card grades than students below the median.[30] However, illness status and school absence was not reported among these students. Follow-up studies were recommended, especially among underserved populations. This was especially true as African American students were excluded due to insufficient numbers. Our study was able to target this type of population and contained a much larger sample for assessing the relationship between asthma status and school attendance.

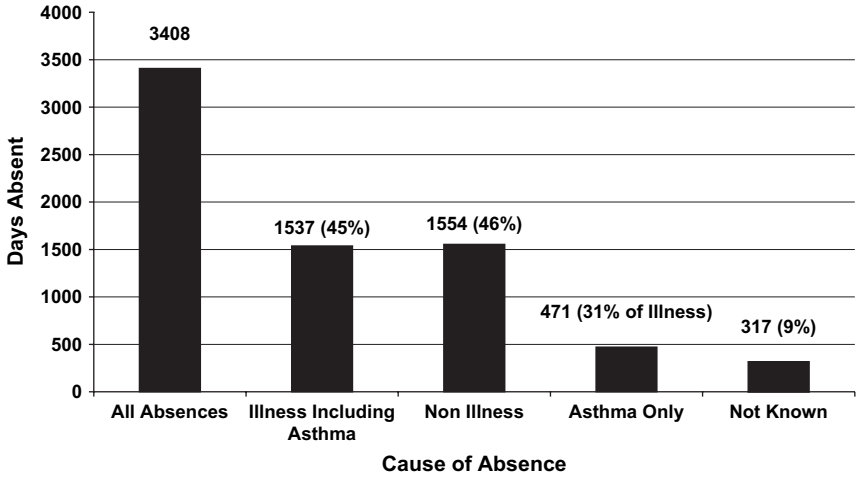
A study in a Louisiana school district outlined which factors put a school at greater risk for poor attendance.[31] They found that schools with the lowest attendance rates were in metropolitan areas, middle and secondary schools, and schools with low SES populations. In accordance with our study, whites missed more school compared with African American students. Our study also showed that whites missed more school than African Americans regardless of

Table 2
Mean Days Absent for All Students and by Asthma Status, Race, Gender, and Grade Level (Entire District—All Schools)

	All Students		Asthma Status			
	(N = 9014)		Yes (N = 874)		No (N = 8140)	
	Days Absent	95% CI*	Days Absent†	95% CI*	Days Absent†	95% CI*
Days Absent	8.3	8.1, 8.5	9.0	8.3, 9.5	7.8	7.7, 8.0
			9.2	8.4, 9.7	7.9	7.7, 8.2
Race						
African American	8.1	7.9, 8.3	8.8	8.2, 9.4	8.0	7.8, 8.2
			9.1	8.5, 9.7	8.0	7.8, 8.2
White	8.2	7.5, 9.0	10.1	6.7, 13.4	8.1	7.3, 8.9
			10.2	6.8, 13.6	8.1	7.3, 8.9
Gender						
Male	8.5	8.2, 8.7	8.9	8.1, 9.8	8.4	8.1, 8.7
			9.4	8.5, 10.2	8.4	8.1, 8.7
Female	7.7	7.4, 7.9	8.8	7.9, 9.6	7.6	7.3, 7.8
			8.9	8.1, 9.7	7.6	7.3, 7.8
Grade						
Elementary	7.0	6.8, 7.2	7.9	7.3, 8.5	6.9	6.7, 7.1
			7.9	7.4, 8.5	6.9	6.7, 7.1
Middle	8.8	8.4, 9.2	11.2	9.5, 13.0	8.6	8.1, 9.1
			11.2	9.5, 12.9	8.6	8.1, 9.1
High	10.4	10.0, 10.8	10.9	8.9, 12.8	10.4	9.8, 10.9
			10.9	9.0, 12.8	10.4	9.8, 10.9

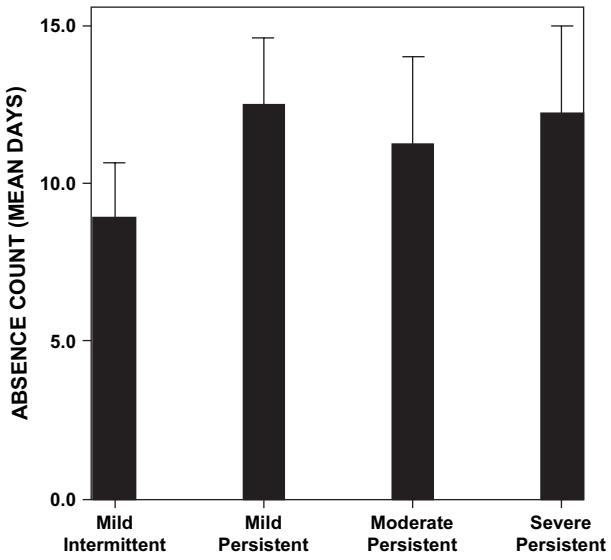
* 95% confidence interval.
† Crude rates top line. Adjusted rates bottom line by race, grade, and days enrolled.

Figure 1
Determinants of Prospectively Tracked Absences Among Those With Asthma (N = 543)



The x-axis represents the absence categories. The y-axis represents the total number of days absent for each category. The bars represent the number and percentage of the total days that were due specifically to illness, non illness, asthma, and unknown reasons.

Figure 2
The Association Between Asthma Severity Level and Mean Days Absent (N = 353)

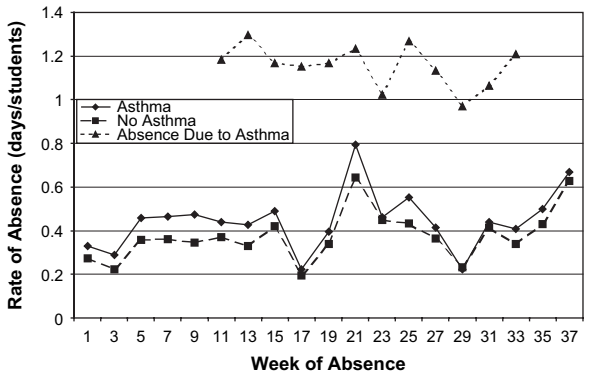


The x-axis represents asthma severity level. The y-axis represents total days absent. The bars represent the mean days absent (crude/unadjusted) and upper 95% confidence intervals for each severity level. Arithmetic values are used for absence days. However, days absent is a log-normal distribution, and the statistical analysis was performed using the log-transformed values.

asthma status. When the lowest attendance groups were combined, it was found that the students at highest risk for poor attendance were students in metropolitan, low-SES, secondary, and middle schools. This supports our findings that the lowest overall absentee rates were among those in high school and the highest among those in middle school. Again, they suggested further studies in underserved minority populations with adequate numbers to determine the relationship between absenteeism and academic performance. Our study did not report on the academic progress of our students, and it would be of interest to determine if asthma severity does indeed impact educational correlates such as grade point average and standardized test scores among this group.

It is important to note that absenteeism was higher for asthma students compared with the nonasthma group throughout the entire study period (Figure 3). This supports the idea that the difference in absenteeism truly exists, not only for the specific allergy or cold-weather seasons when higher rates may be expected due to asthma exacerbations. It has been noted that patterns of absence such as this, along with the chronicity of illness, make it very difficult for children to reach their full academic potential.[32] While an additional 1.3 mean absent days among children with asthma may appear minimal, the repeated, brief episodes of absence throughout the year may indeed have a cumulative affect on school performance. A study among chronically ill patients showed that adolescents who missed only 2 or more days per school in the past 6 months because of their illness had lower academic performance compared to those who missed less than 2 days of school during that time frame.[33] In our study, students with greater than mild intermittent asthma severity, which accounted for 66% of the students assessed for severity, were absent on average an additional 4.3 days as compared to those without asthma.

Figure 3
Absenteeism Over Time of Study Period



The x-axis represents the week of absence (starting August 19 and ending June 2) throughout the study period. The y-axis represents the rate of absence (total number of days absent/number of students). The top line demonstrates the rate of absence due to asthma/illness absences for prospectively tracked absences only (N = 543). The middle line is the rate of absence for asthma students (N = 874). The bottom line represents the rate of absence for nonasthma students (N = 8140).

In our review of the literature, another study was not found that evaluated the reasons for absenteeism in a longitudinal manner among those with asthma. Our study revealed that over 30% of the illness associated absences among children with asthma were due specifically to asthma-related symptoms. Additionally, we were able to target a large African American, urban, poor population incorporating an entire school district. Previous studies of asthma in schools have identified the lack of minorities and insufficient sample size as major limitations. Furthermore, we assessed the important relationship between asthma severity level and absenteeism. Only two other studies to date have looked at severity and absenteeism.[14,34] In these studies, absenteeism was self-reported and only captured through a questionnaire and at one point in time. An additional strength of our study includes the longitudinal approach employed for tracking and determining reasons for absences for those that have asthma over almost an entire school year.

There are several limitations to our study. We were restricted to the school nurse's classification of asthma through information available on health intake forms, presence of an asthma action plan, or contact with the parent/guardian or child. An attempt was made by the investigators to obtain confirmation through a physician diagnosis, but few parents consented to release this information. However, this may have resulted in an underreporting of asthma prevalence due to undiagnosed asthma, and an even greater difference in absenteeism could truly exist if we had identified the entire asthma population. There were varying numbers of consenting participants in each school for evaluation of symptom severity and longitudinal evaluation, as well as the ability for nurses to track absences due to asthma. There is potential for bias in tracking absenteeism. Children with asthma may have found this an easy excuse that would not be challenged by school officials. Additionally, asthma symptom severity was self- or proxy reported, and no quantitative severity measure was provided. However, the frequency of reported symptoms is considered a highly reliable and valid measure of asthma.[18]

CONCLUSIONS

Our study adds to the evidence that asthma puts children at risk of missing more days from school than those without asthma. In addition, a relationship was demonstrated between asthma severity and the number of school days missed. While the relationship is not clear, there is sufficient evidence to suggest that excess absenteeism disrupts the process of learning and affects academic performance. Schools face an economic impact for missed days both from funding issues associated with attendance as well as academic measures which effect accreditation and state funding. Parents who miss work due to their child's asthma are also confronted with economic disadvantage. It is crucial that interventions in the school continue to develop and begin to identify those at greatest risk for asthma-related absences. Two methods demonstrated here to identify children with asthma that is not controlled are absences and symptom severity. These data helped in the design of a school-based program (Asthma 411 Initiative) to target high- or at-risk students with asthma.[35] The program provides tools (eg, computerized asthma education software), methods, and strategies to aid the existing health and administrative structures present in schools. The goal is to help control and reduce the effects of asthma as measured through outcomes such as absenteeism and symptom severity and to serve as baseline measures for the evaluation of success. The effects of excess absence on academic performance also warrant investigation due to conflicting findings in the literature. In addition, missed class time does not always result in an absence, and no information is available on the extent to which this may be a problem in children with asthma and other chronic illnesses. ■

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