

PEDIATRIC ASTHMA

Absence, Extended Absence, and Repeat Tardiness Related to Asthma Status among Elementary School Children

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Background. The purpose of this analysis was to examine potential associations between absence, extended (repeated) absence, tardiness, and repeated tardiness from school and doctor-diagnosed asthma. **Methods.** A cross-sectional analysis was conducted using data collected in fall 2007 on 914 4th and 5th grade school children from seven randomly selected participating schools in DeKalb County, GA. ANOVA was used to compare attendance metrics for race, gender, and asthma status groups. Nonparametric Kruskal–Wallis statistical tests were also done because distributions of attendance metrics were skewed. We tallied daily absence data during the study period and examined absence by day of week. We also compared the variation of the weekly rate of absence and tardiness for students with asthma versus students without asthma over the study period. **Results.** The mean days of absence in 86 students with asthma was 2.73 days compared with 1.89 days for 828 children without asthma ($p = .004$). There was no significant difference in mean days of tardiness by asthma status. The difference in the number of instances of 2+ consecutive days of absence (extended absence) by asthma status was not significant. Students with asthma were more likely to be absent on Mondays ($p = .005$), Tuesdays ($p = .001$), and Fridays ($p = .02$) than students without asthma. The weekly rate of tardiness for students with asthma trended with the general student study population over the study period, whereas the weekly rate of absence did not. **Conclusions.** Asthma was associated with increased 1-day absences but not longer absences or tardiness.

Keywords child and adolescent health, community health, policy, absenteeism, tardiness

INTRODUCTION

About 53 million school days were missed by children 5–17 years old due to injury or illness in the United States in 2008 (1). Male students were responsible for just over half, or about 51%, of missed school days. About 53% of lost school days could be assigned to children aged 5–11 years, or grades K–5. Absenteeism may hinder the learning process—missed lessons, and missed exams, may put children at an academic disadvantage. Moreover, being absent may be a psychological burden on children in terms of peer acceptance or poor academic achievement. Excessive absenteeism is suspected to be a strong predictor of premature school dropout (2). Also, missed school days often translated into missed work days for parents or caregivers, which resulted in economic costs of about \$194.5 million (3).

Seven million U.S. children (9.4%) under 18 years of age in 2008 reported currently having asthma (1). A study derived from data in the 1994–1995 National Health Interview Survey (NHIS) of 62,171 children under age 18 years found that children with disabling asthma had an average of 9.7 school absence days annually compared with children with other disability conditions who lost an average of 5.3 school days (4, 5). According to a 2007 Georgia data summary, about 75,000 (48%) children aged 5–17 years reportedly missed approximately 470,000

school days due to asthma (6). Children 5–17 years of age missed 12.8 million school days due to asthma in 2003 in the United States (7). Other factors have also been reported as having affected annual average daily attendance and school children's health and performance. These included indoor air and environmental quality (8), outdoor or ambient air pollution on school absenteeism due to respiratory illnesses (9), and asthma and/or air pollution on school attendance of primary school children 6–12 years of age (10).

This article reports on the detailed statistical analyses of primary data collected for a primary school-based community participatory study process conducted in DeKalb County, GA, 2006–2008. Specifically, the purpose of our analysis was to examine potential associations between absence, extended (repeated) absence, tardiness, and repeated tardiness and reported doctor-diagnosed asthma in elementary school classes in DeKalb County, GA. Publications from the parent study (11–14) and a previous study by Shendell and coauthors (8) summarized the community-based participatory research planning processes involved in collecting data, presented the absence data in terms of average daily attendance, reported the reasons assessed and prevalence of tardiness and leaving early, and documented the knowledge and awareness of environmental quality indoors and outdoors among nurses and clinical assistants.

METHODS

A cross-sectional analysis of attendance data was conducted to examine the patterns of absence, tardiness,

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extended absence, and repeated tardiness and their potential associations to asthma status of 4th and 5th grade school children in seven randomly selected participating schools in DeKalb County, GA. The primary data collection protocols were IRB approved in Georgia, including use of three different informed consent forms, by Georgia State University and the DeKalb County Schools Department of Research and Evaluation. The secondary analyses reported in this article were approved by the IRB at the University of Medicine and Dentistry of New Jersey.

Data Collection

The main study by Shendell et al. (11–14) involved 914, 4th and 5th graders of seven randomly selected schools in DeKalb County, GA, and was completed in 2006–2008. For more details on the protocol for recruitment and planning of the overall study, please see Shendell et al. (13, 14). For the secondary analyses reported in this article, data were available in the form of a consolidated spreadsheet database.

Doctor-diagnosed asthma as reported on emergency cards of the 4th and 5th grade students was noted on the absence reporting tool. The key measurements of this portion of the original study were absence and tardiness. Absenteeism was defined as absence of a child from school during the entire school day. This definition did not include arriving late to school (tardiness) or leaving school early. To obtain data, a simple spreadsheet-based methodology for collecting information on student absence and tardiness in a three-ring binder in each school's main office, and/or available in electronic form, was used. Six schools chose to implement the attendance data collection system in hard copy. However, one school elected to use the electronic version. The binders were prepared and mailed to schools to arrive by August 17, 2007, to use starting on August 20, 2007. School staffs were assisted with retroactive data entry for August 13–17, 2007. Raw data on absence and tardiness were available in the form of spreadsheets for each classroom in the 4th and 5th grades of each study school. There were 42 classes (21 each for 4th and 5th grades) included in the primary study. Additional information on each student—race, asthma, and gender—was recorded.

For this study, we defined extended absenteeism as 2 or more consecutive days of absence from school during 1 school week or absence on a Friday and at least the subsequent school day (Monday or Tuesday, depending on any holidays observed). Furthermore, we defined repeated tardiness as 2 or more consecutive days of arriving late to school during 1 school week or on a Friday and at least the subsequent school day.

In addition, in this study, there were a number of students who enrolled late in the school year or who only attended for a small part of the school year and then left school. They were not counted in the attendance for a large part of the school year's first semester. These students were indicated in the daily attendance sheets as “not enrolled” by the teachers. We excluded these students who had a large number of days as “not enrolled” as

we thought they would not be representative of the cross section of students. Therefore, we determined a cutoff to exclude students who were “not enrolled,” that is, irregular attendance for one-third of the term or 28/84 days during the school year's first semester, August–December 2007.

Statistical Analysis

Analysis was done by using Microsoft Excel and SAS v.9.2 (Cary, NC, USA). Error checking was carried out and records of students with substantially incomplete data (gender, race, asthma status) were dropped from this analysis. Also, the records of 62 students who missed school for more than 28 days were excluded from the present analysis. We conducted descriptive analyses of absences, tardiness, extended absences (2+ days), repeated tardiness (2+ days), absences around weekends, and 5 or more consecutive days of absence. We also conducted time trend analysis of the absence and tardiness metrics for the general student population and the students with asthma group. PROC analysis of variance (ANOVA) was used to compare absence/tardy/extended absence/repeated tardiness for race, gender, and asthma/non-asthma status.

Upon closer examination of some of our key variables, that is, days absent, days tardy, and extended absences, we found evidence of non-normality. The Kolmogorov–Smirnov D-statistic for the distributions had p -values < .01. Although most parametric methods such as ANOVA are still considered largely applicable when there is mild deviation from normality, we decided to conduct nonparametric analyses of the key outcome variables (days absent, days tardy, and extended absences) versus the major categorical variables—asthma status, gender, and race—to gain further confidence in the present analyses.

To obtain the nonparametric analog of the one-way ANOVA test, we used the PROC NPAR1WAY procedure. The test we used was the Wilcoxon rank test, which produced the Kruskal–Wallis test statistic. Based on the p -value of this statistic, we were able to either reject or not reject the null hypothesis; the median values of the key measurement variables (days absent, tardy, and extended absences) were equal among major categories (asthma status, gender, and race).

RESULTS

The final study sample size was 914 4th and 5th graders in seven randomly selected participating schools of DeKalb County, GA. The study period was the fall semester, August 13 to December 14, 2007. The number of actual class days during the study period was 84. Of the 914 students enrolled for at least two-thirds of the 84 days of the fall semester, 843 students were enrolled for each day. The other 71 students enrolled at some time during the semester or left the study school, that is, they moved out of the area or changed schools for unknown reasons.

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The mean number of instances of extended absence was scarcely higher for students with asthma (0.45) than for students without asthma (0.43), a difference that was not statistically significant ($p = .85$). The mean number of instances of extended absence around weekends in students with asthma (0.07 days) and students without asthma (0.06 days) was similar ($p = .68$). The mean number of instances of extended 5-day absence in students with asthma (0.01) and in students without asthma (0.03) was also similar ($p = .41$).

The mean days of tardiness in students with asthma was 2.53 days compared with 2.15 days for those without asthma ($p = .44$). The mean instances of repeated tardiness are slightly higher among students without asthma (0.29 vs. 0.37); however, this difference was not significantly different given a p -value of .65.

Nonparametric Analysis

Using the Kruskal–Wallis test statistic for days absent by the categories of race, asthma status, and gender, we found that for this outcome variable, the conclusion of statistical significance was the same as with ANOVA for race (not statistically significant, $p = .44$) and asthma (statistically significant, $p = .0003$) categories, but not for gender (statistically significant by the nonparametric test, $p = .01$, not statistically significant by ANOVA, $p = .21$). We also tested days absent, tardy, and extended absences by doctor-diagnosed asthma status category using the nonparametric method. The result for the statistical significance for absences (statistically significant, $p = .0003$) was the same as with ANOVA. Moreover, the result for the statistical significance for tardiness and extended absence by asthma categories were not significant with ANOVA ($p = .44$ and $p = .85$); however, nonparametric analysis revealed that days tardy ($p = .04$) was statistically significant but extended absence was not ($p = .43$).

Trends of Absenteeism and Tardiness

Figure 1 shows the daily absence for 914 students from August 13 to December 14, 2007. It is notable the number of absences are often higher for Mondays than most other days of the week. Indeed, when we summed up the total absence by the day of the week we found that there were 449 absences on Mondays and less than 400 absences for other days of the week (see Table 3). Students with doctor-diagnosed asthma were more likely to be absent than students without asthma on each day of the week and this difference was highly significant on Mondays ($p = .005$), Tuesdays ($p = .001$), and Fridays ($p = .02$).

In Figure 2, the x -axis represents the week of absence over the study period. The primary y -axis (right-hand side) represents the average weekly rate of absence (total number of absences for that day/number of students averaged over the week). Please note the denominator in weeks 4, 9, and 10 went from five to four and in week 15 went from five to three to account for holidays observed on Mondays and the Thanksgiving holiday weekend, respectively. The dashed line is the rate of absence in students with doctor-diagnosed asthma ($n = 86$). The solid line represents the rate of absence for students without asthma ($n = 828$). Figure 2 shows the absent rate for students who had asthma was higher in the fourth–fifth weeks, the eighth–tenth weeks, and the thirteenth–fifteenth weeks, and especially high in the thirteenth week. The thirteenth week was not related to any holiday period. It is yet to be determined why a high rate of absence was observed during this week. More students with asthma were both absent and tardy in the fifteenth week; however, it is important to note this was the week of the Thanksgiving holiday.

In Figure 2, the secondary y -axis represents the average weekly rate of tardiness (total number tardiness for that day/number of students averaged over the week). The dotted line is the rate of tardiness in students who had asthma

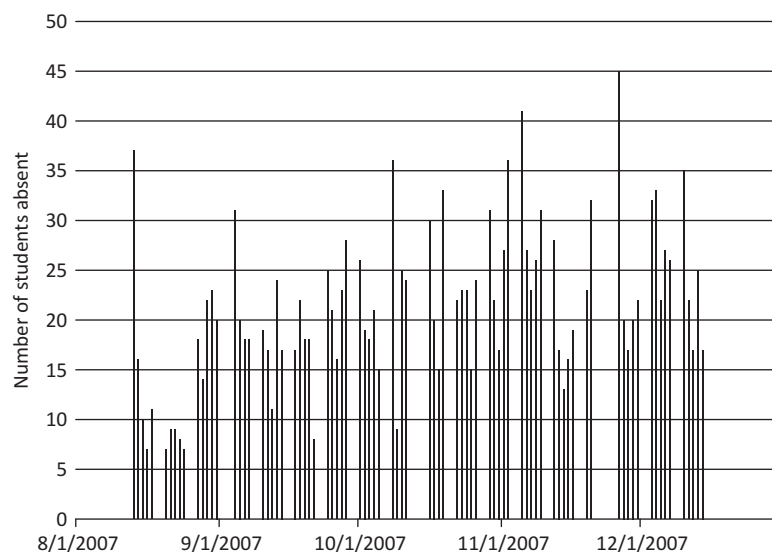


FIGURE 1.—Number of students absent out of final valid study sample ($n = 914$) on school days over the time period of study (13 August–14 December 2007) in DeKalb County, GA.

TABLE 3.—Mean days of absence for students with asthma and students without asthma by day of the week in seven schools in DeKalb County, GA.

	Monday	Tuesday	Wednesday	Thursday	Friday	Total
Mean days for non-asthmatics	0.47	0.39	0.32	0.36	0.35	1.89
Mean days for asthmatics	0.72	0.67	0.38	0.42	0.53	2.72
<i>P</i> -value	.005	.001	.41	.46	.02	.004
Total days of absence	449	385	301	337	332	1804

($n = 86$). The dash-dotted line represents the rate of tardiness in students without asthma ($n = 828$). The trend of tardiness for students with asthma followed very closely to the trend in the students without asthma population.

DISCUSSION

Moonie et al. (2) found that students with asthma were absent approximately 1.5 more days per year compared with those without asthma ($p = .006$). In our study, the mean days of absence in students with asthma was 2.72 days compared with 1.89 days for those without asthma, that is, a mean difference of 0.83 days for half the school year. Prorating for the whole school year, we might expect a difference in absence about 1.7 days, which is similar to the findings of Moonie et al. (2) Silverstein et al. (15) studied a cohort of children with asthma in Rochester, MN, and reported school attendance. In this study, children with asthma had 2.21 (95% CI 1.41–3.01) more days absent in the school year: they observed school attendance for the years 1959 to 1995. This long interval makes it difficult to compare our results with this study, as we know that the prevalence of asthma has been increasing dramatically over the past few decades. The severity of identified cases may also have changed. Another study of Canadian school-age children documented asthma-related hospitalizations peaked about 2.5 weeks after Labor Day, that is,

within 1 month after their return to school following summer vacation (16). It is notable how the present analyses (Figure 2) found increased rates of absence for students with asthma 4–5 weeks after the start of the school year. It is also notable how there was an increase in tardiness on the third week of the semester (early September) just preceding the weeks of increased absence.

Our study is distinctive in that we have reported extended absence (2+ days) as well as absence and tardiness for 4th and 5th grade students in a probability sample of seven elementary schools in one district in DeKalb County, GA. We found only small, nonsignificant differences in multiday school absence, which suggested most absence associated with asthma was of brief duration. To our knowledge, this is the first study to look specifically at extended absence among school children with doctor-diagnosed asthma. We believe it is also the first study to analyze the absence trends of students with and without asthma by day of the week.

Limitations

A large number of students were irregular in their attendance. This was a limitation of this study. We do not know whether the students were pulled out for ESL (English as a second language), special education, medical leave of absence, or family leave of absence. The study geographic area has military bases; students may temporarily come to school for 3 months. Moreover, some students could have been taken to another classroom for discipline problems. In our study, we learned students were pulled out from class for periods of time for various reasons.

There were three limitations specific to asthma status. First, our data do not say whether an absence of a student with asthma was due specifically to an uncontrolled asthma attack. Moonie et al. (2) prospectively tracked absences for students with asthma and found that about half the tracked absences were attributable to illness and of these absences about 30% were associated with asthma-related symptoms. Second, we did not record in our database which children had provided their asthma

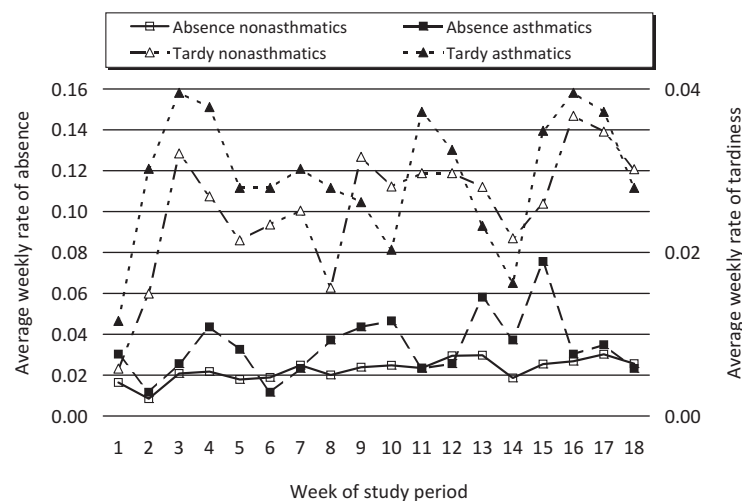


FIGURE 2.—Trends of absence and tardiness by asthma status over the time period of study (13 August–14 December 2007) in DeKalb County, GA.

medication to the nurse. At each study school, anecdotally mid-semester, the nurses stated few students had rescue inhalers stored in the nurse's office or main office and that an unknown number of other students carried them during the day. Finally, we only recorded the doctor-diagnosed asthma status, without severity, because only this and other chronic diseases and allergies were reported to the school administration and district nurses on emergency information cards (which, based on the IRB approval, were what we had access to through a nurse or office staff member who completed a summary for us). These had been completed by a parent, guardian, or caregiver, not a student, as required by law. Neither an actual clinical examination was performed nor a record of symptoms was maintained at study schools. This leaves open the possibility some students designated as not having asthma could actually have had undiagnosed asthma.

Our data suggested if the absence of the students with asthma was due to asthma, the effect of such illness was short lived unlike absence due to flu or cold which often may result in longer absences.

Bonilla et al. (17) reported that the difference in days absent between students with asthma and students without asthma decreased with age, but was relatively small for 9- to 11-year-old children. Our study population enrolled 4th and 5th grade students (also aged ~9–11 years) and produced similar results.

About 44% of missing school days nationwide were attributable to children whose family incomes were less than \$50,000 (1). Therefore, household income may be a socioeconomic status-related indicator of absenteeism. However, we could not study this point in detail because we did not directly have household income data; the only publicly available data on study children, at a grade and/or school level, would be the percent receiving free and/or reduced lunches.

CONCLUSION

This study showed an association of doctor-diagnosed asthma status with elementary school absence, but the effect was modest and was mainly limited to 1-day absences. No significant effect of asthma on tardiness was found. Low attendance and frequent tardiness is associated with poor academic performance and may be a precursor to premature school dropout. Our study thus quantified some secondary dimensions of absence and tardiness, namely, extended absence and repeated tardiness, but did not find statistically significant differences in these measures between students with and without asthma. However, we identified weekly patterns of absence, that is, higher rates of absence for students with asthma on Mondays, Tuesdays, and perhaps Fridays, possibly reflecting asthma exacerbations triggered by weekend activities. A better understanding of these observations, for example, stress- or exercise-induced asthma attack over the weekend, may help identify specific actions such as allowing students to use rescue inhalers in class, in-home follow-up by social workers, or more targeted

interviews/health examinations by school nurses. These efforts could help to achieve higher rates of attendance and hence better performance in schools. Thus, associations reported in this study can inform future decision making by school boards, school nurses, and policy makers concerning use of limited resources.

Future school-based research should further investigate specific documented reasons for recorded absence among school children with asthma and other chronic conditions, and incorporate measures of severity based on reported and observed symptoms and medication use. In addition, future research should strive to include data on indicators of student or family socioeconomic status. For example, we found no publicly available data on an individual student's participation in the free/reduced lunch (or, breakfast and lunch) program in the targeted school district, only school and school-district levels of participation in a subsequent school year.

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DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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