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Outcomes for a Comprehensive School-Based Asthma Management Program

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Abstract

This article describes the evaluation of a comprehensive school-based asthma management program in an inner-city, largely African-American school system. All 54 elementary schools (combined enrollment 13,247 students) from a single urban school system participated in this study. Schools were randomly divided between immediate and delayed intervention programs. The intervention consisted of 3 separate educational programs (for school faculty/staff, students with asthma, and peers without asthma) and medical management for the children with asthma (including an Individual Asthma Action Plan, medications, and peakflow meters). Children with asthma were identified using a case detection program and 736 were enrolled into the intervention study. No significant differences were observed in school absences, grade point average, emergency room visits, or hospitalizations between the immediate and delayed intervention groups. Significant increases in knowledge were observed in the immediate intervention group. This study of a school-based asthma management education and medical intervention program did not show any differences between the intervention and control groups on morbidity outcomes. Our experience leads us to believe that such measures are difficult to impact and are not always reliable. Future researchers should be aware of the problems

associated with using such measures. In addition, connecting children with a regular source of health care in this population was difficult. More intensive methods of medical management, such as school-based health centers or supervised asthma therapy, might prove more effective in inner-city schools.

INTRODUCTION

African-American children have the highest rates of asthma prevalence, morbidity, and mortality[1-12] among racial ethnic groups in the United States. In addition, the highest rates of asthma-related disability are found among African-American children from low-income backgrounds.[13,14] The mortality rate for African-American children younger than 15 years is 7.4 per million versus 1.4 per million for white children and 2.0 per million for children from other racial and ethnic backgrounds.[15] This article describes the implementation and evaluation of a comprehensive school-based asthma management program in an inner-city, largely African-American school system that was designed to address these problems.

METHOD

Subjects

All 54 elementary schools (13,247 students) from a single urban minority (98% African American) system participated in this study from September 1995 to September, 2000. The school system had 7 school nurses for the entire system (including the 54 elementary schools). To ensure proper implementation of the intervention, schools were randomly divided into 3 cohorts. Schools within cohorts were then randomly divided between immediate and delayed intervention programs. The intervention was implemented over 3 years with one cohort receiving the intervention each year. The study was approved and monitored by the University of Alabama at Birmingham's Institutional Review Board.

Case Detection Procedure

We developed and implemented a case detection procedure to identify children with a previous diagnosis of asthma and children who were experiencing symptoms of asthma but did not have a diagnosis.[16,17] The 3-stage case detection procedure was implemented in all 54 elementary schools in first through fourth grades. The first stage of the procedure consisted of a questionnaire. Children were classified as “previous asthma,” “suspected asthma,” or “no asthma” according to the parent's response. The second and third stages of the procedure consisted of spirometry and exercise challenge testing. Students with suspected asthma performed preexercise spirometry using a portable spirometer. Children with $FEV_1/FVCs < 80\%$ were referred to a physician for confirmation of suspected asthma. Students with normal spirometry ($FEV_1/FVCs \geq 80\%$) performed a submaximal exercise challenge step test and were referred to a physician for suspected asthma if they had a greater than 15% decrease in FEV_1 or at least a 25% decrease in FEF_{25-75} from baseline after the exercise challenge.[18] Children identified by the case detection procedure as previously diagnosed asthma or suspected asthma were targeted for intervention.

Intervention

The intervention consisted of 3 separate educational programs and medical management for the children with asthma. The interventions consisted of asthma education for school faculty and staff (*Managing Asthma: A Guide for Schools*19), the general student body (*Asthma Awareness: A Curriculum for the Elementary School Classroom*20), and students with asthma (**Open Airways for Schools**21). Education for the school faculty and staff was provided at an in-service meeting. Asthma awareness classes were provided to all children in each elementary school. Due to academic considerations, classes were usually conducted in large groups during

physical education periods. Students were given the pre- and postknowledge tests provided in the Asthma Awareness curriculum, which includes separately designed versions for grades 1-3 and for grade 4 students. The *Open Airways for Schools* program, designed for children ages 8-11, consists of six 40-minute sessions. Open airways classes were small with children of similar ages grouped together. To accommodate school schedules, educational sessions were shortened to 30 minutes each and intervals between classes varied. At some schools, classes were conducted every other day, while at other schools, classes were conducted once a month. Content was modified slightly for children below the age of 8.

We intended to train teachers at each school to conduct the educational classes for the children. However, teachers were overburdened with academic duties and were not able to participate. These time constraints also prevented the teachers from assisting with the collection of pre- and posttest data. Therefore, beginning in the second cohort, classes were taught by study personnel.

Children within immediate intervention schools who were identified as having asthma were provided a medical consultation with 1 of 2 study physicians (board-certified pediatric allergists) at no cost. The physician confirmed the diagnosis of asthma, determined the proper medication regimen, and developed an Individual Asthma Action Plan. Asthma education was provided at the time of the medical consultation and included reviewing medication techniques, peakflow monitoring, and the Asthma Action plan with the parent and child. The Asthma Action Plan was then delivered to the school nurse and the child's primary care physician. All asthma medications, including rescue medications for school, as well as peakflow meters, were provided for the child during the study.

Delayed Intervention

Children enrolled in the delayed intervention schools who were identified as having asthma were referred to their private physician or the public health department for further evaluation. Upon study completion, children enrolled in the delayed intervention schools were offered a visit with the study physicians at no cost. In addition, all 3 educational programs were conducted in the delayed intervention school upon completion of data collection.

Analyses

The primary outcome of the study was school absences. We intended to collect absences through school records as well as by parental report. However, due to the significant amount of staff time it took to implement the case detection procedure and intervention, parental interviews were not conducted. Secondary outcomes included grades and health care utilization (emergency room [ER] visits and hospitalizations). Grades were collected from school records. ER visits and hospitalizations were collected through medical records at the Children's Hospital of Alabama. Pre- and postasthma knowledge data were also collected from intervention students before and immediately following educational classes. We attempted to collect data on quality of life using parental phone interviews. However, participation was low due to multiple changes in contact information and limitations in available study staff.

Descriptive statistics were calculated at baseline and after intervention. Due to randomization at the school level, the effects of intervention on these outcomes were tested using the Generalized Estimating Equations approach with adjustment of sex, grade, and season.[22] Mixed linear models were constructed to examine changes in knowledge among students to account for the nonindependence of students within randomized schools.

RESULTS

We implemented the case detection program with 13,247 elementary school children and enrolled 736 children with asthma (both previously diagnosed and newly diagnosed by the case detection procedure) into the study. In the immediate intervention group, 82% of the children identified with asthma attended the physician visit, received free medications, and were provided an individualized Asthma Action Plan. It is important to note that the high follow-up rate is a direct result of highly intensive efforts by study staff. Repeated contacts with parents for the scheduling of visits with physicians, rescheduling of missed appointments, and accommodating parental schedules for visits outside normal working hours required considerable staff time. To ensure parental attendance at scheduled appointments, study staff extended additional efforts to secure and provide payment for transportation.

Among the many difficulties encountered when implementing a program in an inner-city school system is the transient nature of the population. Seventeen percent of both the immediate and delayed intervention groups transferred schools during the study period. Twelve percent of these children transferred out of the school system and were lost to follow-up; another 5% transferred between immediate and delayed intervention group schools. As a result of transfers between and out of schools, 610 students were in the final analysis. Table 1 displays the demographic characteristics of the students included in the analysis. The immediate and delayed intervention groups were similar in gender, race, and school grade.

Table 2 shows the mean number of school absences and grade point average for the immediate and delayed intervention groups while Table 3 shows the median number of ER visits and hospitalizations for each group. No significant differences were observed in any of these outcome measures over time or by intervention status.

Data on pre- and postasthma knowledge were available from only the immediate intervention schools in the second and third cohorts (2552 first through third graders from 15 schools and 549 fourth graders from 13 schools). For grades 1 through 3, a statistically significant increase ($p < .0001$) of, on average, 3 points (range 0.23-4.09) was observed across the 15 intervention schools. All 15 schools showed a positive increase in knowledge (see Figure 1). For grade 4, a statistically significant increase ($p < .0001$) of, on average, 0.66 points (range −0.56 to 1.36) was observed across the 13 intervention schools. Twelve of the 13 intervention schools showed a positive increase in knowledge (Figure 2).

DISCUSSION

In this study, we observed a significant increase in asthma knowledge among the intervention group; however, morbidity measures did not change. This is consistent with many studies of school-based educational interventions, which have documented increases in asthma knowledge, self-management skills, and/or self-efficacy but have been unable to demonstrate decreases in morbidity. A study by Clark et al.[23] has documented symptom declines, particularly for children with persistent asthma and significant increases in science grades. This study also found decreases in parent-reported absences (though not school district-reported absences). An earlier study by Evans et al[24] indicated increases in self-efficacy and grades, less negative feelings about asthma, and reductions in children's symptoms but no changes in absences, hospitalizations, or ER visits. A recent meta-analysis of educational interventions for asthma in children assessed 32 studies and found that self-management programs resulted in moderate improvements in measures of airflow and self-efficacy and modest reductions in school absences and ER visits.[25] These effects were greater for those with moderate to severe asthma. While this meta-analysis is encouraging, few of these studies were school based.

Weaknesses of the Study

No changes in school absences, grades, or health care utilization were observed. It is possible that the program was not effective in impacting morbidity outcomes; however, the problematic nature of the implementation process and outcome measurement led us to consider that these outcomes may be unreliable for measuring the impact of asthma interventions in the school. We would like to share some of our experiences with others hoping to implement and evaluate school-based programs.

Reliability of Outcome Measures Data

During this project, we discovered that our primary outcome variables (school absences, grades, and health care utilization) were not as reliable as we had anticipated. We chose to use school absences, as recorded in school records, for a primary outcome variable because these records should provide a more objective method of assessing absences that is free from the bias often associated with self-reported measures. However, in our study, the use of this method had 2 major problems. First, given that school absences are affected by many factors other than asthma-related illness, it is difficult to accurately assess the relationship between asthma and school absences. Data from a more recent study in these schools indicate that only 24% of absences are due to asthma-related illnesses.[26] Second, school records were not a reliable outcome measure. During the period in which the study was conducted, schools received state funding based on daily attendance records. As a result, funding considerations inadvertently contributed to faulty absentee record keeping. Furthermore, the irregular procedure for recording partial day attendance presented another difficulty in assessing school absences. Some children would be counted as “absent” when present for part of the day, while others would be counted as “present,” depending on the time attendance was recorded. As shown in Table 3, the average absence for children in both the immediate and delayed intervention schools (at baseline) was reported to be less than 4 days. This rate is lower than the ranges generally reported in the literature for inner-city elementary school populations (8 to 21 days/year[27,28]) raising suspicion regarding the accuracy of absentee recordings. Additionally, the rate we observed in this study was lower than the rate found in a pilot study completed prior to submission of the grant proposal (mean = 8.3 days). The pilot study relied on parental report of absences rather than school records (as used in the current study). In a more recent study, we used an Internet-based teacher-reporting system to measure absences for children with asthma.[26] Absences for the children ranged from 0 to 54 days during the 5-month project period with a mean of 6.9 (SD = 9.4). Based on this rate for a 5-month period, we would expect a much higher absenteeism rate than what was found in the current study. Given the difficulties encountered in this study, persons examining the impact of programs on school absences should consider the use of parental self-reported measures of absences as potentially more accurate and reliable.

Assessing and measuring grades posed similar challenges. Grades, like school absences, are contingent upon many factors unrelated to asthma and can be difficult to effect with an asthma management intervention. Grade inflation adds an additional layer of measurement complexity. A measurement for grades was rendered useless for special education students since they were not assigned grades in the same manner as other students. Furthermore, grade parameters for first and second grades differed from those for third through fifth grades, making grade comparisons difficult for those students transitioning.

Health care utilization was much more difficult to track in this population than we had anticipated. Our city is organized such that there is a single hospital that provides emergency care and hospitalization for inner-city children with asthma. However, children used many different names and identities upon entering the health care system and were, therefore, difficult to track. The social security numbers that parents provided to study staff often did not match

those given to health care providers. We had planned to gather self-reported data on school absences and health care utilization from the parents. Facilitating parental involvement proved more difficult and more costly than anticipated for several reasons. Parents either did not attend scheduled visits during which self-report data was collected or did not return completed questionnaires to study personnel. Contact and follow-up was problematic because parents and guardians frequently changed phone numbers. The project was, therefore, much more labor intensive than initially projected and, as a result, self-report measures were eliminated for budgetary reasons. However, these self-report measures may be the more reliable and accurate measures in such situations.

Our discussion above indicates there may be instances in which self-report data may be the more reliable and accurate measure. Therefore, it is important to point out that we had planned to collect self-report data on absences, health care utilization, and quality of life from parents. However, because of the significant amount of study personnel time required to implement the program (since the use of school staff or trained volunteers turned out not to be an option), we were not able to collect this data. In addition, the population within which we were working was highly mobile, making contact with parents extremely difficult and time consuming. In our current studies involving this population, we have allotted for a significant amount of personnel time to be spent in maintaining contact with parents. In addition, we now collect home, work, cell phone, and pager numbers from parents as well as these numbers from 3 to 4 contacts (one of whom has lived at the same address for more than 2 years).

Difficulty in Maintaining Fidelity of the Program

We had significant difficulty in maintaining the fidelity of the asthma management program. Students changed schools often and school records of transfers were often not accurate. A high turnover of school faculty and staff further impacted continuity of the project by necessitating repeated interventions for the training of newly hired school personnel. Furthermore, the goal of conducting an effectiveness trial using community resources to implement the asthma education programs was compromised by 2 factors. First, excessive demand on school staff eliminated their use as a source of education for the children. Second, the use of a trained volunteer staff ultimately proved too costly to supervise. One leader of the volunteer organization was hired as study staff, but this individual had great difficulty in maintaining adequate numbers of trained volunteers for the study, leading to repeated trainings. Ultimately, study personnel decided this mechanism was not effective. Finally, due to the time constraints that existed within our school system, the *Open Airways* sessions had to be shortened. While we do not feel that this modification limited the impact of *Open Airways* in these schools (but rather such education was not sufficient to impact health outcomes and our measures of impact were not reliable), it should be noted that altering tested interventions could impact their effectiveness.

Next Steps

While implementation of asthma education programs in schools has been successful in increasing awareness and knowledge about asthma, it is noteworthy that such programs have proven insufficient for significantly altering asthma outcomes for inner-city, low-income, minority children who underutilize health care resources. Recent research has shown that school-based health care can reduce rates of hospitalization and absences in children who have asthma.[27] As asthma intervention research continues to evolve, school-based health centers or other intensive methods of connecting children with medical caregivers in inner-city, low-income school systems should receive increased attention as a method for affecting asthma outcomes.

School-based programs highlight 2 important features for conducting health interventions: (1) collaboration with schools is an effective means of providing education for children with chronic diseases and (2) schools are a logical access point for health interventions. Schools provide access to centrally organized settings with the potential to minimize the necessity of parental attendance typically considered optimal for management programs. However, burden on schools for health management and education are large. Health programs cannot be staffed by teachers who have other academic responsibilities. There are increasing pressures on schools from many health advocacy groups to address health concerns (such as asthma, diabetes, obesity, mental health, violence, and drugs), yet there is little funding for school nurses and health clinics. Given these financial and time constraints, perhaps researchers and health advocates should seek to develop comprehensive health management programs with appropriate, dedicated staff for school-aged children.

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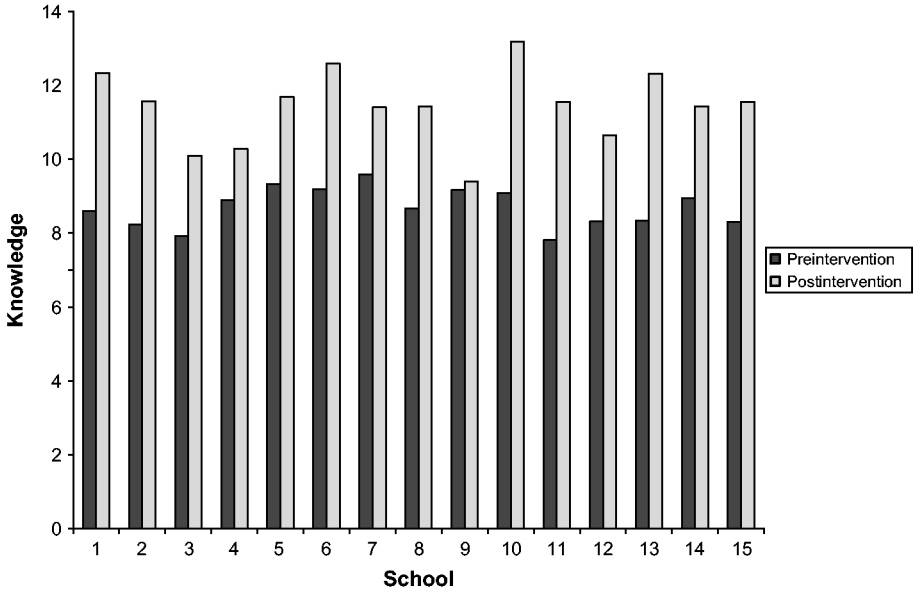

Figure 1.
Pre- and Postintervention Mean Knowledge Scores by School (grades 1-3)

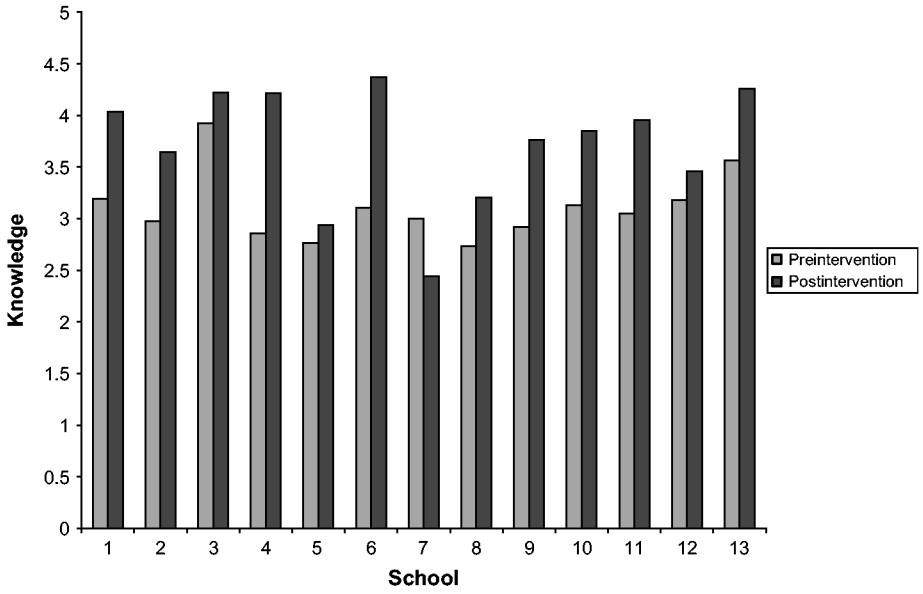

Figure 2.
Pre- and Postintervention Mean Knowledge Scores by School (grade 4)

Table 1

Demographic Characteristics of Intervention and Delayed Intervention Groups

	Intervention %	Delayed Intervention %	p Value
Gender (female)	44	48	0.33
Race (black)	97	97	0.65
Grade			
First	28	24	0.31
Second	23	28	
Third	25	24	
Fourth	24	24	

Table 2

Mean School Absences and Grades for Intervention and Delayed Intervention Groups

	Intervention	Delayed Intervention
Absences		
Baseline	3.81 (SD = 3.6; n = 333)	3.29 (SD = 3.8; n = 275)
Postintervention	3.88 (SD = 3.5; n = 305)	3.21 (SD = 3.2; n = 269)
Grades		
Baseline	79.8 (SD = 9.8; n = 333)	79.7 (SD = 10.0; n = 275)
Postintervention	79.2 (SD = 9.4; n = 305)	80.3 (SD = 8.5; n = 269)

Table 3

Median ER Visits and Hospitalizations for Intervention and Delayed Intervention Groups

	Intervention Mdn (SD) n	Delayed Intervention Mdn (SD) n
ER visits		
Baseline	0.09 (0.30) 333	0.13 (0.37) 275
Postintervention	0.09 (0.28) 305	0.10 (0.31) 269
Hospitalizations		
Baseline	0.01 (0.09) 333	0.03 (0.17) 275
Postintervention	0.04 (0.19) 305	0.02 (0.14) 269