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Do School-Based Asthma Education Programs Improve Self-Management and Health Outcomes?

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Abstract

CONTEXT—Asthma self-management education is critical for high-quality asthma care for children. A number of studies have assessed the effectiveness of providing asthma education in schools to augment education provided by primary care providers.

OBJECTIVE—To conduct a systematic review of the literature on school-based asthma education programs.

METHODS—As our data sources, we used 3 databases that index peer-reviewed literature: MEDLINE, the Cochrane Central Register of Controlled Trials, and the Cumulative Index to Nursing and Allied Health Literature. Inclusion criteria included publication in English and enrollment of children aged 4 to 17 years with a clinical diagnosis of asthma or symptoms consistent with asthma.

RESULTS—Twenty-five articles met the inclusion criteria. Synthesizing findings across studies was difficult because the characteristics of interventions and target populations varied widely, as did the outcomes assessed. In addition, some studies had major methodologic weaknesses. Most studies that compared asthma education to usual care found that school-based asthma education improved knowledge of asthma (7 of 10 studies), self-efficacy (6 of 8 studies), and self-management behaviors (7 of 8 studies). Fewer studies reported favorable effects on quality of life (4 of 8 studies), days of symptoms (5 of 11 studies), nights with symptoms (2 of 4 studies), and school absences (5 of 17 studies).

CONCLUSIONS—Although findings regarding effects of school-based asthma education programs on quality of life, school absences, and days and nights with symptoms were not consistent, our analyses suggest that school-based asthma education improves knowledge of asthma, self-efficacy, and self-management behaviors.

Keywords

asthma; children; schools; patient education; systematic review

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Asthma self-management education is an essential component of high-quality care for children with asthma.[1] However, time constraints can made it difficult for primary care providers to provide education.[2] In addition, some children do not have a usual source of primary care. Asthma education programs have been implemented in clinical settings, homes, and schools to augment education furnished by primary care providers.[3] School-based programs are especially intriguing because they provide education to children in a setting in which they are accustomed to receiving instruction and emphasize teaching children how to manage asthma rather than relying on parents to do so.

In this article we present a systematic review of studies of school-based asthma education programs. Although several systematic reviews on pediatric asthma education have been published previously,[4–7] they only incorporated studies published before 1999. A number of additional studies of school-based asthma education programs have been published since then. Moreover, previous systematic reviews combined findings from studies of school-based asthma education programs with findings from studies of programs provided in other settings that may differ systematically from school-based programs. In addition, we assess some outcomes that previous systematic reviews did not address.

The knowledge-attitudes-behavior frame-work was used to conceptualize the potential impact of school-based asthma education programs. We hypothesized that asthma education would improve 3 intermediate outcomes (knowledge, self-efficacy, and self-management behaviors) and that improvements in these intermediate outcomes would lead to improvements in 4 health outcomes (quality of life, days with symptoms, nights with symptoms, and school absences). Effects on school absences are especially important, because children with asthma miss more days of school than other children, and absences may affect a child's social and intellectual development.[8–10] The effects of asthma education on health care utilization were described in a previous publication.[3]

PATIENTS AND METHODS

Data Sources and Study Selection

Three major databases on medical literature were searched: Medline, the Cochrane Central Register of Controlled Trials, and the Cumulative Index to Nursing and Allied Health Literature. Studies with the following research designs were included: randomized, controlled trials (RCTs), cluster RCTs, controlled clinical trials, and observational studies with contemporaneous comparison groups. Inclusion criteria included publication in English, evaluation of asthma education furnished in schools, analysis of outcomes of interest, and enrollment of children aged 4 to 17 years who had a clinical diagnosis of asthma, symptoms strongly suggestive of asthma, and/or 1 or more previous hospitalizations or emergency department visits for asthma.

The literature search was performed by Dr Coffman in consultation with a medical librarian. She screened titles and retrieved abstracts for potentially eligible studies. These abstracts were then reviewed independently by Drs Coffman and Cabana to identify articles likely to meet the inclusion criteria. They then independently reviewed the full text of these articles to confirm that they met the criteria. In all but 2 cases Drs Coffman and Cabana agreed on the inclusion of articles (κ score = 0.96); in the remaining cases, inconsistencies were resolved through consensus. References cited in included articles were reviewed, but no additional articles that met the inclusion criteria were identified. For each article included in the review, information was extracted regarding the research design, sample size, demographic characteristics of the study population, location, type of intervention, setting, type(s) of health professional(s) providing the intervention, the duration of the intervention, and the population that received the intervention (eg, children, children and parents).

Analysis

The Physiotherapy Evidence Database (PEDro) scale (see Appendix) was used to assess the quality of studies included in the systematic review. This scale, created to rate the quality of RCTs included in the Physiotherapy Evidence Database,[11,12] was derived from 2 scales that were developed by using formal scale-development methods: the Jadad scale and the Delphi list. It contains 1 yes/no item that measures external validity and 10 yes/no items that measure internal validity. A study's PEDro score is calculated by assigning 1 point to each "yes" response to the internal-validity items for a maximum possible score of 10 points. (The item that assesses external validity is not used to calculate the score.) If an article did not report information pertaining to an item, the study received no points for that item.[11] The PEDro scale was used instead of the more widely used Jadad scale, because it incorporates more dimensions of study quality. Originally developed to evaluate studies of pain medications, the Jadad scale emphasizes blinding of providers, subjects, and assessors.[13] Although blinding is an important technique for assuring internal validity, it cannot be implemented in studies of patient education interventions. The PEDro scale contains items that measure blinding but also addresses other determinants of study quality that are not captured by the Jadad scale, such as the similarity of intervention and control groups at baseline and conducting between-group comparisons.[11,12]

To assess the comprehensiveness of the school-based asthma education interventions evaluated, we developed a scoring system based on the National Heart, Lung, and Blood Institute (NHLBI) recommendations for asthma education.[1] The NHLBI recommends that providers educate patients and their caregivers about 4 major topics: basic facts about the pathophysiology of asthma, correct usage of medications, techniques for monitoring symptoms, and the importance of avoiding triggers. Interventions received 1 point if they covered each of these topics, with a maximum possible score of 4 points. Scores were assigned on the basis of information reported in the articles. Studies for which no information was reported regarding the content of the intervention could not be scored. This tool has not been validated.

RESULTS

Dr Coffman screened 358 titles and selected 110 (31%) abstracts for review. Thirty-two potentially eligible (9%) articles were identified and retrieved for further review. Twenty-five (7%) articles[14–38] that presented findings from 24 studies met the selection criteria. Two articles were published on 1 study: 1 article[18] reported the study's main results, and the other compared findings for major subgroups of subjects.[38] We excluded articles for the following reasons: not original research (eg, an editorial), no comparison group; enrolled adults, intervention not directed toward children, did not provide education in schools, and did not assess outcomes of interest.

All but 1 study compared asthma education to usual care for asthma.[14–24,26–37] Although the studies did not define "usual care," the term likely refers to asthma care that children receive from their usual health care provider. There maining study compared the use of a tailored, Web-based, interactive, multimedia intervention with viewing generic Web sites about asthma in school computer centers.[25] One of the studies that compared asthma education to usual care also assessed the impact of combining asthma education with medical care.[14]

Study Characteristics

Characteristics of Intervention—Table 1 presents information regarding select characteristics of the interventions assessed by the studies included in the review. In most

studies (19 of 24), the intervention consisted of group education.[15–24,26–30,32–34,37] Four interventions were provided to individual children by health professionals or interactive computer programs.[14,25,31,36] One intervention combined group classes and individual education.[35] The types of personnel who provided asthma education varied widely. The target populations for the interventions differed. Nine interventions were provided exclusively to children with asthma.* The remaining 15 interventions also incorporated components for parents, school personnel, and/or classmates who did not have asthma.†

Eighteen of the 20 studies for which the content of asthma education interventions was described indicated that participants received education on all 4 topics recommended by the NHLBI.[14–21,24,26–30,33–36] Among the 22 studies that reported the number of sessions during which education was provided, the number of sessions ranged from 2 to 34, with a median of 6 sessions.[15–17,19–37] In the 16 studies for which the duration of the intervention was reported, the time period ranged from 2 weeks to 1 year, with a median of 6 weeks.‡

Methods Used—Among the 24 studies for which recruitment strategies were reported, ≥1 of the following strategies were used: case-finding questionnaires§; letters or telephone calls to parents[15,17,20,28,30,33,35,37]; spirometry tests[21,32]; physical examinations[16]; school medical charts[14,24,26,29,30]; and medical charts from physician practices.[31] Eighteen studies reported the time frame for collection of postintervention data. Time frames ranged from immediately after completion of the intervention[26] to 1 year after completion,[14,17–20,24,25,27,35] with half of the studies using the 1-year interval.

Table 2 presents information on sample size and research design. Sample sizes ranged from 20 to 3443 children, with a median of 197 children. Two of the studies were RCTs.[25,31] Sixteen studies were cluster RCTs that randomly assigned schools rather than children to the intervention and control conditions.‖ There were also 6 observational studies with contemporaneous comparison groups.[16,22,29,33,34,37]

Table 3 displays the studies' total scores on the PEDro scale as well as their scores on individual items. Total scores ranged from 1 to 7 points, with a mean and median of 5 points. Seven was the maximum possible number of points that any of the studies could earn because, as discussed previously, blinding is not possible in studies of patient education interventions. The most common methodologic weaknesses were not reporting data on at least 1 outcome for >85% of subjects enrolled in the study and not reporting whether the allocation of children or schools to intervention and control groups was concealed from the person(s) who determined eligibility for the study.

Population Studied—Twenty studies enrolled elementary school students,[14–21,24,26–31,33–37] and 4 enrolled junior high and high school students.[22,23,25,32] Boys outnumbered girls in all but 4 studies. In 12 of the 19 studies for which children's race/ethnicity was reported, most of the children enrolled were black or Latino.¶ Studies did not measure children's socioeconomic status consistently. Only 9 studies reported asthma severity in a consistent manner.[15,17–19,25,28,31,35,37] In these studies, the percentage of subjects with moderate-to-severe asthma ranged from 9% to 62%.

*Refs 16, 19, 20, 24, 25, 30, 31, 34, and 35.
†Refs 14, 15, 17, 18, 21–23, 26–29, 32, 33, 36, and 37.
‡Refs 14, 16, 17, 19, 20, 24–26, 29–31, and 33–37.
§Refs 14, 16, 18, 19, 21–23, 25, 27, 30, 32, 34, and 35.
‖Refs 14, 15, 17–21, 23, 24, 26–28, 30, 32, 35, and 36.
¶Refs 14, 16, 18, 20, 21, 24–26, 29, 31, 34, 35.

Study Findings

Table 4 summarizes the findings from the studies included in the review.

Asthma Education Versus Usual Care

Intermediate Outcomes

Knowledge of asthma: Twelve studies used responses to true/false or multiple-choice questions to assess the impact of school-based asthma education on children's knowledge of asthma relative to usual care. Two studies were excluded from the synthesis of findings because they combined test scores for children who had asthma with scores of children who did not have asthma.[27,36] Of the 10 remaining studies, 6 revealed that receipt of asthma education was associated with statistically significant increases in knowledge for all children enrolled.[14,16,22,23,29,35] One study revealed a statistically significant increase for children in grades 1 through 2 but not for those in grades 3 through 5.[15] Three studies revealed no statistically significant differences in knowledge between the intervention and control groups.[31,33,34]

Self-efficacy: In 8 studies, Likert-scale instruments were used to determine if school-based asthma education increased children's self-efficacy in managing asthma. For 6 studies it was reported that children who received asthma education experienced statistically significant increases in self-efficacy.[14,15,17,20,29,35] Two studies revealed no statistically significant difference in this outcome.[31,34]

Self-management behaviors: Eight studies measured children's performance of asthma self-management behaviors through direct observation or questionnaires about self-management behaviors. Five of the 8 studies revealed that asthma education was associated with statistically significant improvements in all or most self-management behaviors assessed.[14,16,20,30,35] It was reported for 1 study that asthma education was associated with an increase in appropriate use of controller medications but did not increase appropriate use of reliever medications, use of peak flow meters, or avoidance of asthma triggers.[28] Another study revealed that parents reported improvement in children's self-management behaviors but that children did not.[24] For 1 study no statistically significant difference in self-management behaviors was reported.[34]

Health Outcomes

Quality of life: Eight studies examined the impact of school-based asthma education on quality of life for children with asthma. The studies used 3 instruments that contained yes/no and Likert-scale questions to measure quality of life. It was reported for 4 studies that asthma education was associated with a statistically significant improvement in quality of life relative to usual care.[17,23,27,32] Four studies revealed no statistically significant difference in this outcome.[15,22,30,37]

Days with symptoms: Eleven studies compared the effects of school-based asthma education and usual care on the number of days on which children experienced asthma symptoms. In all cases, data on symptoms were obtained from children or their parents. Five studies revealed that asthma education was associated with statistically significant reductions in the mean number of days with asthma symptoms.[15,16,18,20,34] For 6 studies no statistically significant differences in days with symptoms were reported.[14,19,27,28,33,35]

Nights with symptoms: Four studies assessed whether school-based asthma education affected the number of nights on which children experienced nocturnal symptoms. Two studies revealed that asthma education led to a statistically significant reduction in nights

with asthma symptoms relative to usual care.[15,33] One study revealed no statistically significant difference in nights with asthma symptoms.[28] In another it was reported that nights with symptoms increased among children who received asthma education.[18]

School absences: Seventeen studies compared the effects of school-based asthma education and usual care on school absences. Most studies relied on school records to identify absences. Five studies revealed that children who received the asthma education intervention had fewer absences than children who received usual care.[17–19,26,32] In 1 study a reduction in school absences that approached statistical significance ($P = .07$) was reported.[28] Eleven studies revealed no statistically significant difference in absences between the intervention and control groups.[#]

Sensitivity Analyses—Sensitivity analyses were conducted to determine if our conclusions regarding studies that compared school-based asthma education and usual care would change if the analysis were limited to higher-quality studies or to studies in which the interventions or target populations were similar. To assess the impact of study quality, we conducted 2 sensitivity analyses. First, we limited the analysis to RCTs and cluster RCTs, because these studies were more likely than observational studies to enroll groups of children who were similar at baseline with respect to factors that could affect outcomes. As Table 5 illustrates, limiting the analysis to RCTs and cluster RCTs changes our conclusion regarding the effects of school-based asthma education on quality of life for children with asthma. Four of the 5 RCTs and cluster RCTs that examined quality of life revealed that asthma education was associated with a statistically significant increase in quality of life. However, findings regarding effects on days with symptoms, nights with symptoms, and school absences remained mixed. Findings regarding effects on knowledge of asthma, self-efficacy, and self-management behaviors also did not change.

For our second sensitivity analysis regarding study quality, we restricted our analysis to studies that had PEDro scores of ≥5 points, the mean for studies included in this review (results not shown). In this analysis, knowledge of asthma was the only outcome for which our conclusions differed. When the analysis was limited to studies with PEDro scores at or above the mean, the total number of studies that analyzed this outcome dropped from 10 to 3 studies. Two of these studies reported statistically significant differences in knowledge of asthma, and 1 revealed no statistically significant difference. In contrast, for 7 of the 10 studies included in the analysis of all studies, school-based asthma education was associated with greater knowledge about asthma.

We also examined whether the results would change if the interventions and target populations were more homogenous (results not shown). Limiting the analysis to studies in which the intervention consisted of group classes did not change the results, nor did restricting the analysis to studies that enrolled elementary school students (ie, eliminating studies of junior high or high school students). However, some of our conclusions did change when we limited our analysis to interventions that were provided only to children with asthma and did not include components for parents, school personnel, or classmates. We found that effects on knowledge of asthma and self-efficacy were mixed, although the studies with randomized designs and adequate statistical power reported improvements in knowledge and self-efficacy. In addition, 6 of the 7 studies of interventions provided only to children with asthma revealed no statistically significant difference in school absences.

[#]Refs 14, 16, 20, 21, 24, 27, 31, 33–35, and 37.

Comparisons of 2 Asthma Education Interventions—The study that compared a tailored, Web-based, interactive, educational intervention to viewing generic asthma Web sites revealed that availability of rescue inhalers increased among adolescents who received tailored, Web-based education.[25] Adolescents who received tailored, Web-based education also had fewer school absences resulting from asthma and fewer days and nights with asthma symptoms. There was no statistically significant difference in quality of life between the 2 groups.

One study examined the impact of combining school-based asthma education with medical care for asthma.[14] The authors found that adding a visit with a physician to develop an asthma action plan and a free 1-month supply of medication to the education intervention reduced school absences. However, self-management behaviors, self-efficacy, and knowledge of asthma did not improve.

Publication Bias—We created funnel plots to assess whether publication bias may have led us to overstate the benefits of school-based asthma education (these plots are available from the corresponding author on request). For school absences, the outcome assessed by the largest number of studies, the funnel plot was symmetrical, which suggests that there was not a bias toward publication of studies that reported favorable findings for this outcome. Funnel plots for other outcomes were asymmetrical, but asymmetrical funnel plots do not provide conclusive evidence of publication bias, especially when the number of studies is small.[39]

DISCUSSION

Synthesizing findings across studies of pediatric asthma education was difficult, because there are high degrees of heterogeneity in interventions, target populations, and outcomes assessed. Numbers of sessions, contact hours, and duration of interventions also varied widely, as did the types of personnel who provided asthma education. Target populations for interventions also differed; some interventions focused exclusively on children with asthma, where as others included components for parents, classmates, and school personnel. No study measured all 7 outcomes assessed in this review. Even when the same outcomes were measured, they often were not measured over the same intervals of time or with the same instruments.

Studies of school-based asthma education programs also suffer from 4 major methodologic weaknesses that limit our ability to draw conclusions about this literature. First, the studies did not define “usual care” precisely. Their authors assumed that children in the intervention group received more asthma education than children in the control group but did not verify their assumptions. Effects of school-based programs may be harder to detect when children’s usual providers routinely furnish comprehensive asthma education.

Second, a large proportion of the children enrolled in many studies had mild asthma, which may have limited the interventions’ effects on health outcomes. However, we could not examine whether findings differed across studies as a result of differences in severity of asthma symptoms in the study populations, because the studies did not measure symptoms consistently. Only 1 study conducted a subgroup analysis to assess whether effects differed depending on the severity of a child’s symptoms. The authors reported that school-based asthma education reduced school absences and days and nights of symptoms for children with moderate-to-severe asthma but found no statistically significant difference in outcomes for children with mild asthma.[38] In addition, no studies conducted subgroup analyses to assess whether findings differed according to gender, race/ethnicity, or socioeconomic status.

Third, some studies may not have had adequate statistical power to identify differences between the intervention and control groups for some or all of the outcomes they measured. In many studies, the relative standard errors for many outcomes were high, because the standard errors of the estimates were wide relative to the size of the estimates. Some of the cluster RCTs also lacked statistical power because the average number of children enrolled in the study at each school was less than 10.[14,17,24,27,28,30] In cluster RCTs with small numbers of children per school, variance in outcomes among children within schools is often high, which can limit the studies' ability to discern differences between schools.

Fourth, some of the cluster RCTs included in our review may have overstated the impact of school-based asthma education programs. Cluster designs require that appropriate statistical methods be used to determine if observations are clustered within schools and adjust the standard errors of the estimates if clustering occurs.[40] Seven studies failed to do this and, thus, may have reported inflated estimates of the effects of school-based asthma education on the outcomes they measured.[15,20,24,26,27,35,36]

Despite these limitations, several major conclusions emerged from this systematic review. Most studies that evaluated the effects of school-based asthma education on knowledge of asthma revealed that children who received education were more knowledgeable about asthma than children who received usual care. Asthma education was also associated with improvements in self-efficacy and self-management behaviors. The high degree of consistency in findings regarding effects on knowledge, self-efficacy, and self-management behaviors suggest that multiple types of school-based education interventions can improve these outcomes.

In contrast, findings regarding effects on quality of life, days with asthma symptoms, nights with symptoms, and school absences were mixed. Why might school-based asthma education programs improve intermediate outcomes but have less clear-cut effects on health outcomes? Differences in impact on health outcomes do not seem to be a result of systematic differences in the educational interventions or populations assessed. Studies that evaluated individual education were no more likely to report favorable findings for health outcomes than studies of group education. Also, health outcomes were not consistently more favorable for interventions that included components for parents, classmates, and/or school personnel than for interventions provided exclusively to children with asthma. Restricting the analysis to studies with randomized designs changed our conclusion regarding effects on quality of life, suggesting that in some cases the lack of statistically significant differences between intervention and control groups may have been a result of the lack of equivalence between the groups at baseline with respect to factors likely to influence outcomes. However, limiting the analysis in this manner did not change our conclusions about effects on other health outcomes.

There are 3 possible explanations for the lack of consistent effects on health outcomes. One possibility is that the educational interventions that have been studied to date are inadequate. Most of the interventions included in our review were short-term, stand-alone programs that lasted less than 3 months[**] and/or consisted of 6 sessions or less.[††] Educational messages may need to be repeated more frequently and over longer periods of time to achieve improvements in health outcomes. In addition, many interventions were provided by project staff who were not otherwise employed by the schools and who, thus, had little opportunity to reinforce lessons outside the time set aside for formal instruction.[‡‡]

[**] Refs 16, 17, 19, 20, 24, 27, 30, 31, 33, 34, 36, and 37.
[††] Refs 16, 17, 19–23, 25, 27, 28, 32–34, and 37.
[‡‡] Refs 15, 17, 18, 20, 21, 26–28, 33, 34, and 37.

Second, asthma education interventions may not have been able to address barriers to asthma management in the school setting. For example, some school districts may not have permitted students with asthma to self-carry rescue medication. In addition, schools may not have had on-site health centers or a school nurse on duty full-time to assist students during exacerbations or coordinate with their primary care providers.[41] Schools may also have been a source of exposure to mold and other environmental irritants.

A third possibility is that improvements in knowledge, self-efficacy, and self-management behaviors may not be sufficient to improve health outcomes. Improvements in medical care or a child's environment may also be necessary. For example, many children with persistent asthma may not be able to control their symptoms without appropriate prescription of controller medications by providers, even if they use rescue inhalers as directed and strive to avoid triggers as much as possible. Findings from previous studies suggest that controller medications are underused, especially by low-income children in urban areas.[42–44] The potential benefits of integrating asthma education and medical care emerge from the study that revealed that children who received both medical care and education had fewer school absences than children who received education alone.[14]

Improved self-management may also be insufficient to improve health outcomes for children who live in homes or neighborhoods in which they are exposed to high levels of environmental irritants (eg, cigarette smoke, auto and industrial emissions). The negative effects of cigarette smoke on children with asthma were illustrated in a previous study, which revealed that providing inhaled corticosteroids to children in schools did not improve the health of children exposed to secondhand smoke in their homes.[45] Although none of the studies included in this review examined the effects of exposure to secondhand smoke, it seems likely that exposure to this irritant may have undermined the effectiveness these educational interventions.

A previous meta-analysis of studies published before 1999 assessed 3 of the 7 outcomes we examined: self-efficacy, nights with asthma symptoms, and school absences.[5,7] Our finding that asthma education improves self-efficacy is consistent with this meta-analysis, but findings for nights with symptoms and school absences differ. Whereas we found mixed results for these outcomes, the previous meta-analysis concluded that asthma education reduces nights with symptoms and school absences. However, our findings cannot be directly compared with the previous meta-analysis, because the authors included asthma education programs provided in all settings, where as our systematic review focused on school-based programs.

IMPLICATIONS

This systematic review has demonstrated that school-based asthma education programs enhance knowledge of asthma and self-efficacy and self-management behaviors but have less consistent effects on health outcomes. Short-term, stand-alone asthma education interventions may be insufficient for improving health, especially among children who do not have adequate access to medical care or who have high levels of exposure to environmental irritants. This conclusion is consistent with the NHLBI's recommendation that asthma education be integrated into a comprehensive approach to medical care.[1]

Partnerships between schools and health professionals are likely to be helpful but may be difficult to develop and maintain. Schools face many competing demands that can hinder the implementation of asthma education programs.[16,21,26] In addition, some of the programs included in this systematic review had difficulty engaging children's primary care physicians.[14,18,28,33] Leadership on the part of medical directors of health plans, physician

practices, and clinics may be necessary to promote collaboration. Community asthma coalitions may be able to facilitate partnerships, provide school-based services, or work with families and/or communities to reduce exposure to environmental irritants.[46] School-based health centers and school nurses can also play important roles. The most feasible and most appropriate approaches will probably vary across communities, but greater efforts are needed to improve the health of the growing numbers of children with asthma by creatively disseminating self-management education programs and integrating them with improvements in medical and environmental management.

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ABBREVIATIONS

RCT	randomized, controlled trial
PEDro	Physiotherapy Evidence Database
NHLBI	National Heart, Lung, and Blood Institute

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APPENDIX: THE PEDro SCALE11 FOR ASSESSING STUDY QUALITY

External Validity (1 Question)

1. Eligibility criteria were specified. (yes/no)

Internal Validity (10 Questions)

2. Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received). (yes/no)

3. Allocation was concealed. (yes/no)

4. The groups were similar at baseline regarding the most important prognostic indicators. (yes/no)

5. There was blinding of all subjects. (yes/no)

6. There was blinding of all therapists who administered the therapy. (yes/no)

7. There was blinding of all assessors who measured at least 1 key outcome. (yes/no)

8. Measures of at least 1 key outcome were obtained from >85% of the subjects initially allocated to the group. (yes/no)

9. All subjects for whom outcome measures were available received the treatment or control conditions as allocated, or, when this was not the case, data for at least 1 key outcome were analyzed by "intention to treat." (yes/no)

10. The results of between-group statistical tests were reported for at least 1 key outcome. (yes/no)

11. The study provided both point measures and measures of variability for at least 1 key outcome. (yes/no)

To calculate the PEDro score for a study, count the number of "yes" responses to items 2 through 11. The maximum possible score is 10 points. Item 1 is not used to calculate the score because it concerns external validity and not internal validity.

TABLE 1

Characteristics of School-Based Asthma Education Interventions Assessed (N = 24 studies)

Characteristic	No. (%) of Studies
Type of intervention	
Group classes for students with asthma[a]	13 (54)
Group classes for all students[22,23,27,32]	4 (17)
Group classes for all students plus separate classes for students with asthma[18,21]	2 (8)
Interactive computer program[14,25,36]	3 (13)
Individual education[31]	1 (4)
Group classes plus individual education[35]	1 (4)
Type of personnel delivering intervention[b]	
Community health workers[15]	1 (4)
Health educators[17,20]	2 (8)
Nurses[14,15,26–31,37]	9 (38)
Nurse practitioners[16,35]	2 (8)
Peer counselors[22,32]	3 (13)
Pharmacists[28]	1 (4)
Physicians[14,29,37]	2 (8)
Psychologists[29]	1 (4)
Teachers[19,23,29]	3 (13)
Interactive computer program[14,25,36]	3 (13)
Not stated[18,21,24,33,34]	5 (21)
Target population	
Children only[c]	9 (38)
Children and parents[15,17,29,37]	4 (17)
Children and classmates[22,23,32,36]	4 (17)
Children and school personnel[26,27]	2 (8)
Children, parents, and school personnel[14,28,33]	3 (13)
Children, parents, school personnel, and classmates[18,21]	2 (8)

[a] Refs 15–17, 19, 20, 24, 26, 28–30, 33, 34, and 37.

[b] Percentages do not sum to 100% because in some studies the school-based asthma education intervention was provided by ≥2 types of personnel.

[c] Refs 16, 19, 20, 24, 25, 30, 31, 34, and 35.

TABLE 2

Research Designs and Sample Sizes of Studies Assessed

Authors	Type of Study	Sample Size	
		Children	Schools
Bartholomew et al[14] (2006)	Cluster RCT[a]	503	60
Butz et al[15] (2005)	Cluster RCT	201	7 counties (No. of schools not stated)
Christiansen et al[16] (1997)[b]	Observational with comparison group	52	4
Cicutto et al[17] (2005)	Cluster RCT[a]	239	26
Clark et al[18] (2004)	Cluster RCT[a]	674	14
Clark et al[19] (2005)	Cluster RCT[a]	639	21
Evans et al[20] (1987)[b]	Cluster RCT	239	12
Gerald et al[21] (2006)	Cluster RCT[a]	610	54
Gibson et al[22] (1998)	Observational with comparison group	555	2
Henry et al[23] (2004)	Cluster RCT[a]	3443	32
Homer[24] (2004)	Cluster RCT	44	7
Joseph et al[25] (2007)	RCT	314	6
Levy et al[26] (2006)	Cluster RCT	243	14
McCann et al[27] (2006)	Cluster RCT	193	23
MeGhan et al[28] (2003)	Cluster RCT[a]	136	18
Parcel et al[29] (1980)[b]	Observational with comparison group	104	8
Patterson et al[30] (2005)	Cluster RCT[a]	173	22
Persaud et al[31] (1996)[b]	RCT	36	10
Shah et al[32] (2001)	Cluster RCT[a]	251	6
Toelle et al[33] (1993)[b]	Observational with comparison group	120	Not stated
Velsor-Friedrich et al[34] (2004)	Observational with comparison group	102	8
Velsor-Friedrich et al[35] (2005)	Cluster RCT	52	4
Yawn et al[36] (2000)	Cluster RCT	87	1 (3 classrooms randomized)
Young et al[37] (2001)	Observational with comparison group	20	2

[a] Authors stated that they tested for clustering at the school level and adjusted for it if necessary.

[b] The study was included in the Wolf et al[7] (2002) meta-analysis on pediatric asthma education.

TABLE 3

Study Quality Scores (Maximum Possible Points: 10)

	Eligibility Criteria Specified[a]	Random Allocation	Allocation Concealed	Groups Similar at Baseline	Subjects Blinded	Providers Blinded	Assessors Blinded	Data on at Least 1 Outcome for >85% of Subjects	All Subjects Received Allocated Treatment or ITT Analysis	Between-Group Statistics Reported for at Least 1 Outcome	Both Point Estimates and Measures of Variance for at Least 1 Outcome	Total Score
mew et 06)	1	1	0	0	0	0	0	0	1	1	0	3
l[15]	1	1	0	1	0	0	0	1	1	1	1	6
nsen et 97)	1	0	0	0	0	0	0	0	1	1	1	3
et al[17]	1	1	1	1	0	0	0	1	1	1	1	7
al[18]	1	1	0	1	0	0	0	0	1	1	0	4
al[19]	1	1	0	0	0	0	0	1	1	1	0	4
al[20]	1	1	0	1	0	0	0	1	1	1	1	6
t al[21]	1	1	0	1	0	0	0	0	1	1	1	5
et al[22]	1	0	0	1	0	0	0	0	1	0	1	3
al[23]	1	1	0	0	0	0	0	0	1	1	1	4
4 (2004)	1	1	0	1	0	0	0	0	1	1	1	5
t al[25]	1	1	0	1	0	0	0	1	1	1	1	6
al[26]	0	1	0	1	0	0	0	0	1	1	0	4

	Eligibility Criteria Specified[a]	Random Allocation	Allocation Concealed	Groups Similar at Baseline	Subjects Blinded	Providers Blinded	Assessors Blinded	Data on at Least 1 Outcome for >85% of Subjects	All Subjects Received Allocated Treatment or ITT Analysis	Between-Group Statistics Reported for at Least 1 Outcome	Both Point Estimates and Measures of Variance for at Least 1 Outcome	Total Score
et al[27]	1	1	0	1	0	0	0	1	1	1	0	5
et al[28]	1	1	0	1	0	0	0	1	1	1	0	5
al[29]	1	0	0	0	0	0	0	0	1	0	0	1
n et al[30]	1	1	0	1	0	0	0	1	1	1	1	6
et al[31]	1	1	0	1	0	0	0	0	1	1	1	5
al[32]	0	1	1	1	0	0	0	1	1	1	1	7
al[33]	1	0	0	1	0	0	0	1	1	1	1	5
riedrich 2004)	1	0	0	0	0	0	0	1	1	1	1	4
riedrich 2005)	1	1	0	1	0	0	0	0	1	1	1	5
al[36]	0	1	0	1	0	0	0	0	1	1	0	4
t al[37]	0	0	0	0	0	0	0	0	1	0	1	2

s in the column labeled “Eligibility Criteria Specified” were not used to calculate the total score on the PEDro scale. ITT indicates intention to treat.

TABLE 4

Findings From Studies of School-Based Asthma Education Programs

Study	Knowledge of Asthma	Self-Efficacy	Self-Management Behaviors	Quality of Life	Days of Symptoms	Nights of Symptoms	School Absences
Bartholomew et al[14] (2006)	Greater knowledge ($P < .0001$)	Greater self-efficacy ($P = .0027$)	Daily self-management: higher score ($P = .001$); exercise pretreatment: higher score ($P = .0049$); self-management of exacerbations at home: higher score ($P = .0128$); self-management of exacerbations away from home: NS; trigger management: higher score ($P < .0001$)	—	NS	—	NS
Butz et al[15] (2005)	Grades 1–2: 1.70 points (maximum score: 15) ($P < .0001$); grades 3–5: 0.48 points (maximum score: 15) ($P = .18$)	2.73 points (maximum score: 27) ($P = .005$)	—	0.06 points (maximum score: 7), NS	Fewer days ($P = .007$)	Chest tightness/discomfort: fewer nights ($P = .02$); shortness of breath: fewer nights ($P = .03$); wheezing: fewer nights ($P = .02$)	—
Christiansen et al[16] (1997)[a]	4.20 points (maximum score: 17) ($P < .00001$)	—	Inhaler: 2.30 points (maximum score: 7) ($P < .00001$); peak flow meter: 2.00 points (maximum score: 8) ($P < .00001$)	—	−1.49 points (maximum score: 15) ($P = .0188$)	—	−0.59 absences over 1 y ($P = .6439$)
Cicutto et al[17] (2005)	—	0.20 points (maximum score: 5) ($P < .05$)	—	0.50 points (maximum score: 7) ($P < .05$)	—	—	−1.30 absences over 1 y ($P < .05$)
Clark et al[18] (2004)	—	—	—	—	−17.00% ($P < .0001$)	40.00% ($P < .0001$)	−8.00% over 1 y ($P < .05$)
Clark et al[19] (2005)	—	—	—	—	−2.83 d over 1 y ($P = .13$)	—	−0.23 absences over 1 wk ($P = .02$)
Evans et al[20] (1987)[a]	—	3.00% ($P = .04$)	11.00% ($P = .05$)	—	−15.80 d over 1 y ($P = .004$)	—	−0.80 absences over 1 y, NS
Gerald et al[21] (2006)	—	—	—	—	—	—	0.15 absences, NS
Gibson et al[22] (1998)	Greater knowledge ($P < .05$)	—	—	Activity: 0.46 points (maximum score: 7), NS; emotional: −0.20 points (maximum score: 7), NS; environmental: 0.15 points (maximum score:	—	—	—

Study	Knowledge of Asthma	Self-Efficacy	Self-Management Behaviors	Quality of Life	Days of Symptoms	Nights of Symptoms	School Absences
				7), NS; symptoms: −0.16 points (maximum score: 7), NS			
Henry et al[23] (2004)	Greater knowledge (P = .0001)	—	—	0.27 points (maximum score: 7) (P = .003)	—	—	—
Homer[24] (2004)	—	—	Child's responses: −0.20 points (maximum score: 5), NS; parents' responses: 0.37 points (maximum score: 5) (P = .003)	—	—	—	0.68 absences over 1 y, NS
Joseph et al[25] (2007)	—	—	Availability of rescue inhaler: 6.60 percentage points (P = .01); controller medication adherence: 7.80 percentage points (P = .09); smoking cessation/reduction: 0.01 percentage points (P = .89)	1.20 relative risk of increase in quality of life (P = .35)	0.50 relative risk of having any days with symptoms over 2 wk (P = .003)	0.40 relative risk of having any nights with symptoms over 2 wk (P = .009)	0.30 relative risk of having any absences over 30 d (P = .006)
Levy et al[26] (2006)	—	—	—	—	—	—	−3.80 d over 8 mo (P < .05)
McCann et al[27] (2006)	*b*	—	—	15.80 percentage points in percent with improvement ≥2 points (P = .02)	NS	—	NS
MeGhan et al[28] (2003)	—	—	Appropriate use of preventive medications: 28 percentage points (P < .001); appropriate use of reliever medications: 3 percentage points, NS; takes steps to avoid triggers: 2 percentage points, NS; uses a peak flow meter: 11 percentage points (P = .08)	—	Chest tightness: −3 percentage points over 2 wk, NS; coughing: −11 percentage points over 2 wk, NS; shortness of breath: −7 percentage points over 2 wk, NS; wheezing: 3 percentage points over 2 wk, NS	−5 percentage points over 2 wk, NS	−17 percentage points over 12 mo (P = .07)
Parcel et al[29] (1980)[a]	Grades kindergarten through 2: 0.94 points (P < .05); grades 3–5: 1.62 points (P < .05)	0.80 points (P < .05)	—	—	—	—	—
Patterson et al[30] (2005)	—	—	41.00% with correct technique (P < .001)	0.20 points (maximum score: 7) (P = .32)	—	—	—
Persaud et al[31] (1996)[a]	−0.10 points (maximum score: 20) (P = .9)	1.4 points (P = .17)	—	—	—	—	−1.2 absences over 20 wk, NS
Shah et al[32] (2001)	—	—	—	13.7 percentage points in % with clinically	—	—	−1.50 absences (P < .05)

Study	Knowledge of Asthma	Self-Efficacy	Self-Management Behaviors	Quality of Life	Days of Symptoms	Nights of Symptoms	School Absences
				significant improvement (0.5 points) (P = .01)			
Toelle et al[33] (1993)[a]	0.30 points, NS	—	—	—	−0.01 percentage points in percentage with ≥1 d per 3 mo, NS	−35.50 percentage points in percentage with ≥1 night per 3 mo (P < .05)	−0.75 absences over 6 mo, NS
Velsor-Friedrich et al[34] (2004)	0.70 points (maximum score: 25), NS	0.08 points (maximum score: 5), NS	−0.54 percentage points, NS	—	−0.23 d over 2 wk (P = .047)	—	−5.37 absences over 1 y, NS
Velsor-Friedrich et al[35] (2005)	2.40 points (maximum score: 25) (P = .03)	0.27 points (maximum score: 5) (P = .01)	8.14 percentage points (P = .01)	—	−4.00 percentage points in percentage with ≥1 d over 2 wk, NS	—	4.49 absences over 1 y, NS
Yawn et al[36] (2000)	*b*	—	—	—	—	—	—
Young et al[37] (2001)	—	—	—	0.58 points (maximum score: 7), NS	—	—	NS
Summary							
No. of studies	10	8	9[c]	9[c]	12[c]	5[c]	18[c]

Reported are the differences in mean outcomes for intervention and control groups. Where both preintervention and postintervention data were available, the "difference in difference" in mean outcomes was calculated (ie, difference in scores, days with symptoms, etc, for the intervention group minus difference for the control group). If only postintervention data were available, differences in mean outcomes after the intervention were estimated. In some cases, no numerical data on outcomes were available. Sig indicates statistically significant difference between the intervention and comparison groups (P < .05); NS, no statistically significant difference between the intervention and comparison groups; —, not assessed.

[a] Indicates that the study was included in the Wolf et al[7] (2002) meta-analysis on pediatric asthma education.

[b] Study was omitted from analysis of effects of school-based asthma education on knowledge of asthma because responses of children with asthma were combined with responses of classmates who did not have asthma.

[c] Includes both studies that compared asthma education to usual care and studies that compared 2 different asthma education interventions.

TABLE 5

Number of Studies With Findings Favoring School-Based Asthma Education, According to Research Design

Outcome	All Studies	RCTs and Cluster RCTs	Observational Studies With Comparison Groups
Knowledge of asthma	7 of 10	4 of 5	3 of 5
Self-efficacy	6 of 8	5 of 6	1 of 2
Self-management behaviors	7 of 8	6 of 6	1 of 2
Quality of life	4 of 8	4 of 6	0 of 2
Days with symptoms	5 of 11	3 of 8	2 of 3
Nights with symptoms	2 of 4	1 of 3	1 of 1
School absences	5 of 17	5 of 13	0 of 4

Findings that favored school-based asthma education were defined as those that found that participating in a school-based asthma education program was associated with a statistically significant ($P < .05$) improvement in the outcome.