

MANAGEMENT, EDUCATION & ADHERENCE

## Preliminary Evidence for the Feasibility of a Stress Management Intervention for 7- to 12-Year-Olds with Asthma

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**Objective.** Evidence supports a bidirectional relationship between stress and asthma exacerbations in children, suggesting that interventions to reduce stress may improve both psychosocial quality of life and disease course. Here, we examine the feasibility of a stress management intervention for 7- to 12-year-olds with asthma. **Methods.** Two trials were conducted. Cohort 1 ( $n = 11$ ) was recruited from the community and attended intervention sessions at an urban university. Cohort 2 ( $n = 7$ ) was school based and recruited from an African American charter school. Six individual intervention sessions focused on psychoeducation about asthma, stress, and emotions; problem-solving and coping skills training; and relaxation training paired with physiological feedback. Pre- and post-intervention stress, mood, and lung function data were collected. Satisfaction surveys were administered after intervention completion. **Results.** The intervention was rated as highly acceptable by participating families. Feasibility was much stronger for the school-based than the university-based recruitment mechanism. Initial efficacy data suggest that both cohorts showed pre- to post-intervention improvements in lung function, perceived stress, and depressed mood. **Conclusion.** Findings provide evidence for the feasibility of offering asthma-related stress management training in a school setting. Initial findings offer support for future, large-scale efficacy studies.

**Keywords** asthma, stress, child, psychosocial, relaxation, stress management

### INTRODUCTION

Asthma is the most common chronic illness among children in the United States (1) and a leading cause of disability, accounting for more emergency room visits, hospitalizations, and school absences than any other chronic medical condition of childhood (2). The Centers for Disease Control and Prevention estimates that there are currently 10 million children with asthma in the United States (3), making the social and economic costs of the disease considerable.

Although estimates of childhood asthma prevalence vary considerably from 6% to 15% (4), consistent evidence shows disproportionately high morbidity and mortality among minority and socio-economically disadvantaged children living in urban areas (5–8). Children from low-income families are significantly more likely to be hospitalized for asthma and to experience more frequent and severe symptoms of asthma compared with their high-income asthmatic counterparts (8–10). Disparities in asthma morbidity are not fully accounted for by

disparities in asthma prevalence, and it is widely accepted that multiple factors converge to make asthma worse for high-risk urban children (11). Accordingly, recent recommendations advocate the identification of modifiable risk factors associated with disparities in asthma morbidity that can be targeted for intervention (12).

Consistent evidence shows that variations in environmental exposures and access to appropriate health care only partially account for the marked disparities in asthma morbidity (11, 13–14). For this reason, recent attention has focused on the contribution of psychosocial factors that often accompany socio-economic disadvantage (15). In this regard, converging cross-sectional and prospective evidence from clinical, psychological, and biological literatures suggests that psychological stress increases risk for asthma exacerbation in children (15–18). For example, Turyk et al. (19) recently showed positive associations between stressful life events and asthma symptoms, number of physician visits, frequency of hospitalizations for asthma, and asthma-related school absenteeism among 2026 adolescents with asthma in the Chicago Asthma Prevalence study. Further evidence that stress predicts asthma morbidity comes from prospective studies of children with asthma, with acute negative life events (e.g., moving, loss of a loved one, family problems) predicting a twofold increase in subsequent risk of an asthma episode, with risk increasing to threefold among children

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who also live under conditions of high chronic stress (20–22).

In summary, the empirical literature provides evidence that psychological stress is associated with increased subjective reports of asthma symptoms and objective declines in pulmonary functioning and predicts future asthma exacerbations in children. In light of evidence that socioeconomically disadvantaged children report more chronic stress and more frequent stressful life events (23–24), it is widely suggested that psychological stress contributes to disparities in childhood asthma morbidity (25). Evidence that stress precipitates exacerbation of asthma in children led to our interest in whether psychological interventions designed to help children manage stress could improve the physical health of high-risk children with asthma.

Available studies suggest that psychological interventions for pediatric asthma are associated with improvements in the child's emotional health, increases in adaptive coping (26), and decreases in internalizing problems (27–28). With regard to improvements in the physical health of children with asthma, a systematic review published in 1999 examined six studies and concluded that links between relaxation training and improved pulmonary function were promising (29). A more recent review examined physical benefits of biofeedback training among individuals with asthma; however, findings were mixed (30). Authors of both reviews concluded that further research was warranted.

In general, the available literature examining physical benefits of adjunctive psychological interventions for childhood asthma is limited by a failure to focus on samples at high psychosocial risk or employ interventions that are shown to be effective at reducing levels of stress. These general limitations make it difficult to form clear conclusions about the effects of stress management on asthma morbidity and highlight a need for further, more rigorous research (30).

To date, no studies have examined the health benefits of a comprehensive stress management intervention for children with asthma. Accordingly, we have developed a six-session, asthma-specific stress management and coping skills training intervention that is based on the principles of cognitive behavioral therapy (CBT) and supplemented with biofeedback-assisted relaxation training. Evidence suggests that socially disadvantaged children have poorer asthma problem-solving skills and self-management behaviors and that these children lack knowledge of asthma and its treatment as compared to their more advantaged counterparts (31, 32). Therefore, the individualized intervention also includes education about the nature of asthma and its treatment and the development of an individualized asthma-coping plan. This study was designed to assess the feasibility of offering this intervention to 7- to 12-year-old children with asthma, with an emphasis on identifying an effective means of accessing children at high psychosocial risk.

## METHODS

We report on two feasibility trials of our manualized stress management intervention (“I Can Cope”) for 7- to 12-year-old children with asthma. Trial 1 was conducted in the psychology department of a large urban university, enrolling volunteers recruited from community advertising and pediatric asthma practices. Trial 2 was conducted at an urban charter school that serves African American children in the same city. In both trials, data were collected from a guardian and the child with asthma at two time points: (1) within the 2 weeks prior to the first intervention session and (2) 2 weeks after the end of the intervention (2–3 months after the Time 1 assessment). Primary outcomes were intervention feasibility and acceptability. Preliminary data were also collected with regard to lung function [forced expiratory volume in 1 second (FEV<sub>1</sub>)], as assessed by spirometry, and child symptoms of depression, anxiety, and perceived stress.

### *The “I Can Cope” Intervention*

The “I Can Cope” intervention is an adaptation of more generic stress management interventions based on the principles of CBT that have been shown to improve coping and reduce levels of perceived stress in children (33). The intervention and accompanying manual and workbook were created by a multidisciplinary group, including members of the pediatric asthma team at one of the area's general hospitals, pediatric psychologists with experience in the development and application of CBT stress management interventions for children, and a specialist in biofeedback and management of physiologic arousal.

The intervention includes six 50-min individual sessions that provide education about (1) the child's disease, (2) how thoughts, feelings, actions, and physical arousal interact with asthma symptoms, and (3) methods of managing thoughts and emotions related to asthma or other life stressors (Table 1). The program includes training in a range of coping skills designed to help the child manage stress and emotional arousal. In addition to CBT skills, relaxation training is facilitated by the pairing of relaxation exercises with physiological feedback to give children a concrete visual analog of their physiologic state. Specifically, relaxation is paired with (1) electromyography (EMG) feedback with an upper trapezius placement to increase awareness of dysfunctional bracing, (2) hand temperature feedback to make levels of sympathetic arousal conscious and (3) respiratory feedback to provide information about inspiration and expiration.

All sessions involve didactic training followed by a 20-min relaxation exercise, and participants are given audio recordings of relaxation exercises and asked to practice for 15 min each day. In the final session, each child develops an individualized asthma-coping plan to prepare him/her to handle early asthma-warning signs, with a focus on bolstering asthma-related self-efficacy. Finally, participants are given a workbook which includes session worksheets, relaxation practice and other homework logs,

TABLE 1.—Overview of “I Can Cope” intervention sessions.

Session 1: <i>Introduction; stress and breathing</i>	<i>Didactic session:</i> Introduction to program; overview of asthma; relationships among stress, breathing, and asthma; patterns of breathing <i>Relaxation training:</i> Diaphragmatic breathing with respiratory biofeedback; pursed lip breathing <i>Homework:</i> Orientation to homework and point reward system; daily relaxation practice; stress and hand temperature logs
Session 2: <i>Physical response to stress</i>	<i>Didactic session:</i> Physical response to stress; relaxation response and relaxation methods; benefits of physical exercise and playing <i>Relaxation training:</i> Body awareness scan with thermal biofeedback <i>Homework:</i> Daily relaxation practice; stress log
Session 3: <i>Thoughts and feelings</i>	<i>Didactic session:</i> Relationships between thoughts and feelings; cognitive coping strategies (e.g., thought distortions); muscle tension <i>Relaxation training:</i> Progressive muscle relaxation with muscle tension biofeedback <i>Homework:</i> Daily relaxation practice; thought records
Session 4: <i>Coping with emotions</i>	<i>Didactic session:</i> Emotions and physical arousal; emotion tolerance skills (calm thoughts, emotional expression and release, shifting attention) <i>Relaxation training:</i> Guided imagery with thermal biofeedback <i>Homework:</i> Daily relaxation practice; worksheet in modifying dysfunctional thoughts
Session 5: <i>Thoughts, feelings, and asthma</i>	<i>Didactic session:</i> Relationship of asthma with thoughts, emotions, actions, and bodily responses; asthma-specific thoughts and feelings <i>Relaxation training:</i> Child choice of relaxation exercise and biofeedback <i>Homework:</i> Daily relaxation practice; worksheet in applying coping skills
Session 6: <i>Coping plan</i>	<i>Didactic session:</i> Review of skills; construction of personalized asthma-coping plan; maintenance of gains; program feedback <i>Relaxation training:</i> Child choice of relaxation exercise and biofeedback

a record of coping skills, and the child’s individual asthma plan. Home practice is charted by families and reviewed at the beginning of each session.

Reinforcement for participation is provided by awarding tokens in session and at home for practicing coping skills. Tokens are converted into financial rewards (i.e., a store gift card) at the end of the program. The program is tailored to match the developmental capabilities of 7- to 12-year-olds who typically have the capacity to participate in an interactive intervention and are beginning to assume independence in the management of their asthma.

### Participants

For Trial 1, inclusion criteria included (1) having a diagnosis of moderate, persistent asthma, confirmed by

physicians using American Thoracic Society (ATS) criteria, (2) receiving one to two daily controller medications and being stable on this medication regimen for 2 months, (3) speaking English as a principal language, and (4) being between the ages of 7 and 12 years. Exclusion criteria included (1) taking non-asthma-related prescription medications and (2) having other chronic illness(es). No exclusions were based on race, ethnicity, or gender.

Participants in Trial 1 ( $n = 14$ ) were recruited from the community at various times throughout the year via (1) the pediatric pulmonary/asthma departments at two hospitals, (2) local asthma events (e.g., fairs, basketball clinics), (3) invitation letters to patients at local pediatric practices, (4) an advertisement in the local Respiratory Alliance chapter newsletter, and (5) letters to pediatricians. Despite these recruitment efforts, only 40 guardians expressed interest in their child’s participation over a 2-year period. Of these, 15 were ineligible (37.5%), primarily because the child did not meet criteria for moderate, persistent asthma. Another 11 guardians were not interested because of the location of the university campus in a congested, urban area. This resulted in a final sample of 14 participants, of whom 11 completed the protocol (78.6%). The dropouts happened after the first intervention session and were related to scheduling difficulty ( $n = 2$ ) or repeated hospital admissions ( $n = 1$ ). Barriers to child participation resulted in a sample of children who were largely from families of middle to high socio-economic status and were not representative of patterns of asthma morbidity. For this reason, we conducted a second feasibility trial adapting the intervention to a school setting and targeting children at higher psychosocial risk.

Participants in Trial 2 ( $n = 8$ ) were recruited from an urban charter school that serves a low-income population (81% receive free or reduced price lunches). Participants were recruited at a single evening informational session held at the school in March 2008. Of the 80 children in Grades 4 and 5, the school nurse identified 11 children from 10 families as having asthma and carrying an inhaler. Their caregivers were invited to attend the informational session. Of the 10 identified families, 8 families (9 children) came to the session, and 7 families (8 children) consented to participation. Thus, eight out of nine eligible children were consented (89%). Of these eight children, one relocated to a different school during the intervention and was lost to follow-up. Thus, seven of eight participants completed the intervention (88%). In both trials, informed consent was acquired in compliance with the guidelines of the participating Institutional Review Board(s).

### Procedure

In Trial 1, eligibility and baseline lung function ( $FEV_1$ ) was assessed at an outpatient appointment at one of two participating pulmonary/asthma clinics. The child and his/her guardian then attended eight visits to the university study offices over 2–3 months. Participants completed pre- and post-intervention psychosocial questionnaires

during Visits 1 and 8; Visits 2–7 were the intervention sessions. Prior to each intervention session, the clinician met with the child and his/her guardian for 10 min to provide an overview of the intervention, to engage the guardian in reinforcing home practice, and to address questions or concerns. Trial 1 intervention sessions were led by two senior graduate students who had basic training in CBT and received at least 25 hours of didactic and experiential training to conduct the manualized intervention. Weekly supervision was provided by a pediatric psychologist and social worker with Biofeedback Certification Institute of America certification. Within 2 weeks of the final intervention session, the child and his/her guardian returned to the hospital clinic to complete Time 2 spirometry.

Trial 2 commenced with an evening informational session, during which the family provided consent for participation, baseline measures of lung function ( $FEV_1$ ) were obtained, and Time 1 psychosocial questionnaires were completed. Following this session, children received six intervention sessions during the school day over a period of 2–3 months. To educate caregivers about the skills their child was learning and address questions or concerns, interventionists telephoned caregivers before each session, and caregiver handouts were sent home following each session. A second assessment session was held at the school to complete follow-up spirometry ( $FEV_1$ ), psychosocial questionnaires, and satisfaction surveys. The school-based intervention sessions were led by a senior graduate student, a master's level clinician, and an advanced research assistant. Interventionists received the same basic training and weekly supervision as in Trial 1.

### Measures

The child participant and his/her guardian completed a battery of psychosocial questionnaires at Time 1 and Time 2 visits. On each occasion, a research assistant read all questions aloud to the child and recorded his/her responses. Guardians completed the questionnaires in a separate room from the child. Questionnaires included the following:

- *Perceived Stress Scale* (PSS) (34). The total score from this widely used and reliable 10-item measure was used to assess the degree to which children perceive situations in their lives as stressful (Cronbach's coefficient alpha = 0.85) (34).
- *Child Depression Index* (CDI) (35). The total score from this widely used, 27-item, self-report measure was used as a continuous measure of depressive symptoms. In addition, a score greater than 13 was used as a cutoff for possible clinical depression (36). Internal reliability coefficients are generally >0.80, with test–retest reliability coefficients ranging from 0.38 to 0.87 (36).
- *The State–Trait Anxiety Inventory for Children* (STAIC) (37). Both the state and trait anxiety scales from this reliable 40-item, self-report measure of anxiety symptoms were used (38). As recommended by Vila and colleagues (39), a total

trait anxiety score of 34 was used as a cutoff for clinical anxiety.

- *Profile of Mood States* (POMS) (40). The depressed, anxious, and angry mood subscales from this 14-item measure were used to measure mood state. The scale was adapted for use with children (41).
- *Child Behavior Checklist (CBCL)—Parent Report Form* (42). Caregivers completed this widely used, well-validated standardized questionnaire. The internalizing, externalizing, and total problems scales were used in analyses.
- *Demographic Information Form* (Time 1 only). Caregivers reported background information, including their own and their child's age, sex, and race and their own relationship to the child with asthma, highest level of education, and marital status.
- *Satisfaction Survey* (Time 2 only). Child participants and their caregivers responded on a four-point scale (poor to excellent) to six questions assessing acceptability, enjoyment, and usefulness of the intervention (Table 2). They were also asked to identify the most and least helpful components of the program and to suggest how the intervention could be improved.

Pulmonary function was assessed by spirometry, an objective measure widely used to assess risk for future asthma exacerbation. Spirometry provides a measure of  $FEV_1$  taken both in the absence and in the presence of albuterol, with an improvement in  $FEV_1$  of >12% and 200 ml considered to be significant under normal conditions. Measures were obtained using KoKo Pneumotach spirometers (nSpire Health, Longmont, CO, USA), with company-provided software installed on laptops. The Pneumotach is a handheld device that connects to the computer. Participants were asked to take a deep breath and blow as hard and long as they could into the Pneumotach. When they had no air left, they were told to take a deep breath back in through the device. The provided software measured the amount and strength of airflow. The spirometers were calibrated daily using the manufacturer's 3.0 L calibration syringe. KoKo spirometers meet ATS testing standards (43).

## RESULTS

### Demographics

Participants in Trial 1 were 14 children aged 7–12 years ( $M = 9.5$  years,  $SD = 1.4$ ; 57% male; 64% Caucasian). Guardians were all female (13 biological mothers and 1 maternal grandmother), ranging in age from 33 to 52 ( $M = 41$  years,  $SD = 6.3$ ), with an average of 16 years of education ( $SD = 2.6$ ). Of these, 72% were married, with the remaining being never married (14%), separated (7%), or widowed (7%). At baseline, one child (7%) endorsed elevated depression symptoms (CDI score

TABLE 2.—Means and standard deviations for child and caregiver responses on the satisfaction survey.

Questions	Trial 1		Trial 2	
	Child ( <i>n</i> = 11)	Caregiver ( <i>n</i> = 11)	Child ( <i>n</i> = 7)	Caregiver ( <i>n</i> = 4)
To what extent has participation in the program helped you?	2.4(0.67)	1.8(0.63)	2.7(0.49)	2.0(0.82)
How would you rate the whole program?	2.6(0.52)	2.8(0.42)	2.7(0.49)	2.5(0.58)
Would you tell a friend with asthma that he/she should take part in this program?	2.6(0.50)	2.8(0.42)	2.7(0.49)	3.0(0.00)
Have the things you have learned in this program helped you to deal with upsetting events (stress) in your life?	2.6(0.52)	2.5(0.71)	2.6(0.53)	3.0(0.00)
Are you happy with the help you received in the program?	2.6(0.52)	3.0(0.00)	2.6(0.53)	2.8(0.50)
Did you enjoy the training?	2.5(0.70)	n.a.	2.6(0.53)	n.a.

Scores are based on a 0 (poor) to 3 (excellent) rating scale.

$\geq 13$ ) and four children (29%) endorsed elevated anxiety symptoms (STAIC trait scale  $\geq 34$ ). At follow-up, two children (14%) endorsed CDI scores in the depressed range ( $\geq 13$ ) and one child (9%) endorsed elevated anxiety symptoms (STAIC score  $\geq 34$ ). None of the parents reported CBCL scores in the borderline or clinical ranges at either time point. All participants in Trial 1 had moderate, persistent asthma and took daily controller medications.

Participants in Trial 2 were eight children, ranging in age from 8 to 11 years ( $M = 9.0$  years,  $SD = 1.1$ ; 75% male, 100% African American). Guardians ranged in age from 31 to 63 years ( $M = 40.1$  years,  $SD = 10.6$ ) and reported an average of 13.3 years of education ( $SD = 2.4$ ). Sixty-three percent of guardians reported never being married, 25% reported being divorced, and 12% reported being married. At baseline, six children (75%) endorsed elevated depression symptoms (CDI  $\geq 13$ ) and seven children (88%) endorsed elevated anxiety symptoms (STAIC trait scale  $\geq 34$ ). On the CBCL, externalizing and total problems were reported to be in the borderline range for one child (12.5%) and in the clinical range for another child (12.5%). At follow-up, none of the children endorsed elevated depression symptoms, six children (86%) endorsed elevated anxiety symptoms, and two children (29%) had CBCL scores in the clinical range.

All participants in Trial 1 met diagnostic criteria for moderate, persistent asthma and were taking one or two daily controller medications. Level of asthma severity was not an eligibility criterion in Trial 2; however, five participants (63%) reported taking two or three daily controller medications, suggesting a diagnosis of moderate, persistent asthma, and three participants (37%) did not take daily controller medications, suggesting a diagnosis of mild asthma. On the basis of symptom report, four participants (50%) had mild to modest symptom severity, and four participants (50%) had moderate

symptom severity. Most participants reported poor asthma control.

#### Acceptability

In both trials, feedback from participants, guardians, interventionists, supervisors, and school personnel was uniformly positive, and therapists were able to adhere to the manual consistently. Mean ratings from the satisfaction surveys administered to child participants indicated overall satisfaction with the intervention (Table 2). Indeed, all child participants indicated that the intervention was good or excellent overall, helped them deal with stress, and was enjoyable. Participants reported that they would recommend the intervention to a friend with asthma. In open-ended questions, children indicated that the most helpful components of the intervention included learning relaxation techniques, listening to recorded relaxation exercises between sessions, understanding how to identify and deal with troubling thoughts and feelings, and learning skills to deal with asthma. Several children indicated a desire for more sessions, particularly additional relaxation techniques.

Satisfaction reports of guardians were equally positive, indicating that the overall quality of the intervention was good or excellent, that they would recommend the program to other families of children with asthma, and that the program helped their child to deal with asthma attacks (Table 2). Guardians indicated that the most helpful components of the program included learning the relaxation and coping strategies, having recorded relaxation exercises to practice between sessions, and receiving the intervention on a one-on-one basis. Several guardians commented that their child was showing an increased sense of responsibility and control over their asthma as a result of participating in the intervention. Guardians reported that their children used the skills from the intervention to avoid asthma episodes as well as to handle

non-asthma-related sources of stress, including school and peers. Compliance with home relaxation practice was reported by children and guardians to be excellent, and child participants appeared motivated by the positive reinforcement contingencies (earning store certificates).

#### *Preliminary Efficacy Data*

Assessment of intervention efficacy was not the primary goal of this research, and our ability to detect reliable treatment-related changes in stress, affect, or pulmonary function was limited by the small sample size. Nonetheless, preliminary findings were encouraging. Across both trials, participants showed improvements in perceived stress (PSS), depression scores (CDI), and depressed, anxious, and angry mood (POMS; Table 3). In addition, participants showed mean improvements in lung function across time points, with increases in lung volume evident for all but one participant, regardless of season of intervention. Given considerable differences between the demographic characteristics of the two samples, we also examined the data separately for these groups (Table 3). Results were consistent.

## DISCUSSION

Evidence that psychological stress precipitates asthma exacerbation in children suggests that interventions designed to help children manage stress and improve asthma-related coping could improve physical health, particularly among socio-economically disadvantaged urban youth who report more psychological stress (23–24) and greater asthma morbidity (5–8) than their more advantaged counterparts. Goals of this study included the development of a stress management intervention for high-risk children with asthma and evaluation of the intervention's feasibility in two different settings.

Results of the initial, university-based trial did not provide compelling support for feasibility. Despite considerable recruitment efforts, it took 2 years to identify 40 interested families, of whom 25 met eligibility criteria. Furthermore, 11 families (44%) did not consent to participate because of the location of the study offices in a busy, urban setting; the number of study visits; and/or their busy schedules. Thus, the participation rate for Trial 1 was 56%. Also, this trial did not recruit a socio-economically representative sample of children with asthma, with a bias toward more highly educated, two-parent families. Despite problematic recruitment, initial evidence supported intervention acceptability. Attrition was low, child participants were motivated to complete home relaxation practice and other assignments, and the intervention was viewed positively by all involved.

To address problems with recruitment and lack of a representative sample, we conducted a second feasibility trial adapting the intervention for a school setting and targeting children with lower SES, which places them at higher risk for asthma morbidity. For this purpose, we offered the intervention at an urban charter school that serves a low-income population. Recruitment data for the second

trial were promising, with 89% of eligible families consenting. Retention rates were also high, with only one child failing to complete the program due to relocation to another school. As with the first trial, the intervention was well accepted by all involved, including the school principal and staff who requested that we offer the intervention again the following year. Thus, Trial 2 provided considerable support for the feasibility and acceptability of offering the "I Can Cope" intervention in schools, which provide a mechanism to access high-risk children with asthma.

The goal of this study was to address questions of feasibility. Therefore, examination of efficacy is preliminary and is intended to inform the decision about whether to move forward with a larger, randomized trial. Participants in both trials showed improvements in psychosocial and pulmonary function from pre- to post-intervention. Further, the external validity of these effects is strengthened by replication in a second cohort that differed with regard to method of recruitment, season of enrollment, demographics, and location of intervention. That said, it is possible that positive changes reflect regression to the mean rather than intervention-related improvements. Similarly, factors other than relaxation and cognitive restructuring may underlie treatment effects, such as a possible increase in medication adherence. Questions of efficacy and mechanisms should be addressed more fully in future work.

Although preliminary, our findings are consistent with prior studies demonstrating psychological benefits of interventions designed to reduce stress in children with asthma (26–28) and extend these findings to suggest a physical health benefit. Here, results support previous findings that relaxation training is associated with improvements in physical health, including improved pulmonary function (29, 44). However, to our knowledge, we provide the first intervention that supplements relaxation training with emotional management and asthma-specific problem-solving and coping skills training. Furthermore, ours is one of the first studies to provide evidence for the feasibility of a school-based intervention that can access urban children from low-income families with heightened levels of stress and increased asthma morbidity risk.

Acceptability and preliminary efficacy findings suggest that replication and extension of this work in a larger randomized clinical trial should be the focus of future research. This future work would benefit from larger sample sizes to permit the examination of covariates known to influence asthma morbidity, such as disease severity, medication use, degree of asthma control, and the role of seasonal fluctuations, which were not incorporated into this work. Future work should also follow participants beyond the end of the intervention to assess the long-term clinical significance of findings, begin to assess the active components of the intervention, and investigate mechanisms underlying clinical improvements. In these trials, more reliable assessment of treatment fidelity and homework compliance, such as recording of intervention sessions and better monitoring of home practice, will

TABLE 3.—Comparison of psychosocial variables and lung function before and after participation in the “I Can Cope” stress management intervention.

Outcome variable	Cohort 1			Cohort 2			Combined cohorts		
	Time 1 Mean (SD)	Time 2 Mean (SD)	t-Value	Time 1 Mean (SD)	Time 2 Mean (SD)	t-Value	Time 1 Mean (SD)	Time 2 Mean (SD)	t-Value
Perceived stress (PSS)	20.27(3.32)	9.82(4.98)	4.44**	22.29(6.73)	16.57(3.82)	2.60*	21.06(4.84)	12.44(5.57)	5.00**
Depression (CDI)	6.82(3.49)	4.91(6.19)	1.07	19.00(11.72)	5.57(1.99)	3.23*	11.56(9.64)	5.17(4.90)	2.79*
Angry mood (POMS)	2.92(2.23)	2.25(1.55)	1.00	4.57(2.82)	2.14(2.19)	2.44*	3.53(2.53)	2.21(1.75)	2.28*
Anxious mood (POMS)	2.50(1.62)	1.42(1.38)	1.52	3.29(2.06)	2.29(2.22)	2.65*	2.79(1.78)	1.74(1.73)	2.28*
Depressed mood (POMS)	2.33(1.44)	1.00(1.04)	3.37**	4.14(2.80)	2.00(1.16)	2.42*	3.00(2.16)	1.37(1.17)	4.02**
State anxiety (STAIC)	54.09(3.86)	54.82(4.88)	-0.51	29.00(7.90)	28.00(2.71)	0.31	44.33(13.75)	44.39(14.06)	-0.037
Trait anxiety (STAIC)	30.27(4.98)	27.73(6.47)	1.00	40.43(7.19)	36.71(4.50)	1.77	34.22(7.67)	31.22(7.22)	1.75
Lung function (Spirometry)	1.78(0.43)	1.96(0.40)	-3.03*	1.61(.32)	1.66(.25)	-0.53	1.70(0.38)	1.82(0.36)	-2.19*
Internalizing problems (CBCL)	53.10(6.30)	51.30(8.43)	0.62	54.50(9.40)	57.25(19.23)	-0.50	53.50(6.95)	53.00(11.93)	0.196
Externalizing problems (CBCL)	49.10(6.90)	46.70(8.87)	1.02	60.25(14.71)	59.75(15.06)	0.11	52.29(10.50)	50.43(12.01)	0.917
Total problems (CBCL)	52.00(7.18)	48.50(11.05)	1.42	58.50(13.53)	60.50(17.64)	-0.52	53.86(9.34)	51.93(13.71)	0.914

Note. PSS, Perceived Stress Scale; CDI, Children's Depression Inventory; POMS, Profile of Mood States; STAIC, State-Trait Anxiety Inventory for Children; CBCL, Child Behavior Checklist.

Participation in the intervention was associated with lower reported symptoms of perceived stress and depression; reductions in angry, depressed, and anxious mood; and higher lung function, as measured by spirometry.

\* $p < .05$ .

\*\* $p < .01$ .

permit the examination of treatment dose. Finally, future school-based trials will need to focus on improving caregiver compliance with completion of post-intervention questionnaires. In contrast to Trial 1, where all caregivers provided Time 2 data, only four of seven (57%) caregivers in Trial 2 provided these data, despite multiple contacts and a small financial incentive.

Despite these limitations, we have documented the feasibility and acceptability of offering "I Can Cope" to 7- to 12-year-old children with asthma in urban schools and provided preliminary evidence for intervention-related decreases in perceived stress and improvements in lung function. From a clinical standpoint, the current findings raise the possibility that a school-based stress management program may benefit high-risk children with asthma. The school-based program was highly acceptable, with self-reported rates of adherence surpassing those observed for pharmacological treatment in pediatric samples (45). This suggests that a nonpharmacological adjunct to traditional asthma care could be a valuable tool in asthma management. By teaching children to identify early warning signs and to apply asthma management skills at these early stages, asthma exacerbations may be curtailed. Finally, our results suggest that the school is an accessible, acceptable context for offering this training.

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#### DECLARATION OF INTEREST

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

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