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A randomized clinical trial of a culturally responsive intervention for African American women with asthma

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Abstract

Background—Few interventions have focused on the difficulties that African American women face when managing asthma.

Objective—To evaluate a telephone-based self-regulation intervention that emphasized African American women's management of asthma in a series of 6 sessions.

Methods—A total of 422 African American women with persistent asthma were randomly assigned to either an intervention or control group receiving usual care. Behavioral factors, symptoms and asthma control, asthma-related quality of life, and health care use at baseline and 2 years after baseline were assessed. Generalized estimating equations were used to assess the long-term effect of the intervention on outcomes.

Results—Compared with the control group, those who completed the full intervention (6 sessions) had significant gains in self-regulation of their asthma (B estimate, 0.73; 95% CI, 0.17–1.30; $P < .01$), noticing changes to their asthma during their menstrual cycle (B estimate, 1.42; 95% CI, 0.69–2.15; $P < .001$), and when having premenstrual syndrome (B estimate, 1.70; 95% CI, 0.67–2.72; $P < .001$). They also had significant reductions in daytime symptoms (B estimate, 0.15; 95% CI, 0.27 to 0.03; $P < .01$), asthma-related hospitalization (B estimate, 0.51; 95% CI, 0.00–1.02; $P < .05$), and improved asthma control (B estimate, 1.34; 95% CI, 0.57–2.12; $P < .001$). However, neither group changed over time in outcomes.

Conclusion—Despite high comorbidity, African American women who completed a culturally responsive self-management program had improvements in asthma outcomes compared with the

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control group. Future work should address significant comorbidities and psychosocial issues alongside asthma management to improve asthma outcomes in the long term.

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Introduction

Sex discrepancies in asthma prevalence and outcomes are evident in the United States. Compared with men, women are significantly more likely to report asthma (8.3% vs 6.2%)¹ and greater disruption of quality of life attributable to asthma.² Furthermore, women have more asthma hospitalizations compared with men, even when accounting for greater prevalence and use of inhaled corticosteroids.^{2,3}

Research and practice efforts continue to overlook one of the most vulnerable subgroups who experience a dual burden of racial and sex disparities in asthma outcomes: African American women. African American women have the highest mortality rate of all groups attributable to asthma.⁴ The asthma literature has only recently begun to describe differences in the origin, natural history, and management requirements of asthma that may be attributable to the sex or gender and race of the patient.² Sex or gender roles for females may increase exposure to asthma triggers, such as cosmetics or child-rearing. The asthma disparity that African American women experience may be explained by multifactorial causes and include less use of anti-inflammatory medicines, especially inhaled corticosteroids,^{5–8} lack of access to quality medical care, lack of asthma education and support, social environment, socioeconomic status, cultural influences that may not align with the medical management of asthma, and racial discrimination.^{9,10} One study has suggested that genetic variants in African American patients may influence differences in bronchial smooth muscle tone and pulmonary function in a symptom specific way.¹¹ No study is conclusive, but considered together, these reports suggest that these sex, race, and genetic influences may be significant.

Only one large trial¹² could be located that has assessed the efficacy of an asthma self-management program specifically designed for women. Women Breathe Free (WBF), which was developed by our research group and formed the basis of the current intervention, is a 6-session telephone counseling intervention that uses a health educator and a self-regulatory problem-solving process to help participants engage more effectively in their asthma management.¹³ Self-regulation is the process of being observant and making judgments based on observation (vs habit, fear, tradition, and so on). In the evaluation of the WBF, the trial included too few African American women to determine whether positive effects were realized for that group.

There is substantial evidence that social, cultural, and socioeconomic factors may affect the ability of African American women to engage in optimal asthma self-management.^{14–16} To date, no rigorously evaluated intervention has focused on the specific concerns that African American women face in the management of asthma. This randomized clinical trial evaluated a self-regulation intervention that emphasized African American women's concerns and sex and gender role factors in the management of asthma, as well as leveraging cultural strengths within the African American community. The hypotheses were that during

a 2-year period, women in the intervention group when compared with women in the control group would exhibit greater reductions in symptoms, urgent care use for asthma, and the number of management problems related to sex and gender roles. Furthermore, greater improvements in asthma control, quality of life, self-regulation, and self-confidence to perform asthma management tasks were expected in women in the intervention group.

Methods

Study Design and Sample

A 2-group randomized clinical trial study design was used with African American women seeking care for asthma in Southeast Michigan who met study criteria. All study procedures were approved by the University of Michigan Medical School Institutional Review Board. Patients were assigned randomly to an intervention or usual care group using a random number generator in SAS statistical software, version 9.4 (SAS Institute Inc, Cary, North Carolina), by the statistician (P.X.K.S.). Usual care was defined as treatment and education within health care settings at the time of clinic visits based on National Asthma Education Prevention Program (NAEPP) Guidelines¹⁷ for the Diagnosis and Management of Asthma. This education did not emphasize sex and gender issues or provide culturally specific information.

Patients with an asthma diagnosis were selected for participation and contacted via mail and telephone. The inclusion criteria for study participants were as follows: (1) identify as a woman 18 or older, (2) diagnosis of asthma by a physician, (3) persistent asthma symptoms in the past 12 months (as defined by NAEPP), (4) self-identify as African American, (5) no extenuating respiratory conditions (eg, emphysema, chronic obstructive pulmonary disease), (6) not pregnant at time of recruitment, and (7) access to a telephone. Primary recruitment was through the University of Michigan Health System where lists of potential participants with a diagnosis of asthma from the University of Michigan Health System Asthma Registry were periodically generated. Secondary recruitment methods included posting on the University of Michigan's clinical trial research database, partnering with Blue Cross Blue Shield of Michigan to identify members in the geographic area who met study criteria, and community recruitment. Eligible patients were mailed a packet that included consent forms, a study overview page, and a letter from the project director and received a follow-up recruitment call. On returning a signed consent form, participants were enrolled in the study and randomized by a statistician after baseline data collection.

Figure 1 shows the participation trajectory of women approached for the study. During the 3-year recruitment period (2011–2014) a total of 1,315 women (46 through the community) were identified and mailed recruitment materials. Of those, 843 women were successfully reached via telephone, and a total of 444 women (53%) consented to participate. Women who declined participation (n = 301) did so primarily because of a lack of interest (n = 63), perception of no asthma diagnosis (n = 52), feeling too busy (n = 43), no reason (n = 136) via telephone or by mailing in a decline postcard, and other reasons (n = 7), such as asthma not being a priority health concern. Failure to contact women via telephone was attributable to nonworking or changed telephone numbers (n = 146) or multiple unsuccessful call attempts and unreturned voice messages (n = 326). Ultimately, 422 of those who consented

provided baseline data. To enhance recruitment and retention of participants, we used a number of strategies including providing modest monetary incentives and using research staff who have worked within the African American population.

Intervention

The intervention is based on WBF,¹² grounded in social cognitive theory and principles of self-regulation. The adapted intervention of WBF was culturally responsive to the specific needs of African American women (Table 1). Culture-related influences on asthma management were integrated into each counseling session.

The program was delivered by trained health educators through a series of 6 telephone counseling sessions (30–45 minutes in duration, 2 weeks apart)¹³ to participants randomized to the intervention (n = 212). Health educators had master's level training in public health or social work and also identified as African American. The content of the intervention reinforced priority messages put forth by the NAEPP guidelines for asthma.¹⁷ All participants assigned to the intervention were mailed an asthma education kit, including a program workbook, asthma symptom diaries, a peak flow meter with instructions, and asthma resources by the health educator.

The first month of the intervention was devoted to self-observation. Participants were instructed on how to use a daily asthma diary. During the observation month, they received weekly postcards to remind them to complete asthma diaries and a mid-month telephone call from the health educator. Fifty-one percent of intervention participants completed the diaries in full.

Participants were offered a list of potential asthma management problems, including those associated with their sex and gender roles, culture, and other relevant challenges. Examples include feeling symptoms when doing housework, wheezing when exercising, family thinking prayer is all that is needed to take care of asthma, and so on. After 1 month of self-observation, participants were asked by their health educator to select an aspect of their asthma management they would like to focus on for overall improvement. During the counseling sessions, participants were introduced to the self-regulatory problem solving process and were encouraged to examine factors that affect asthma management, including sex and gender roles and cultural influences. The health educator guided the participant in applying the problem-solving process to an identified goal. Each subsequent session focused on sequentially teaching and reinforcing the steps of self-regulatory problem-solving processes: problem identification, self-observation, goal setting, evaluation of progress, and establishing rewards for positive behavioral change. During the fourth and fifth counseling sessions, the health educator worked with the participant to identify any problems in achieving goals and formulating potential solutions together. A final booster telephone contact was made 6 months after the fifth session.

Measures and Data Collection

Self-reported recall data were collected by telephone interview at baseline (before randomization) 12 and 24 months after baseline. Data collectors were masked to the assignment of the participants to the study arms.

Symptoms and Asthma Control

Participants were asked the mean nights in the past month they experienced asthma symptoms and how many days per week they experienced daytime symptoms. Self-reported responses were classified based on NAEPP guidelines.¹⁷ Asthma control was measured using the 5-item, validated Asthma Control Test (ACT).^{18,19} The ACT scores were also classified based on NAEPP guidelines for well controlled, not well controlled, and poorly controlled.¹⁷

Asthma-Related Quality of Life

The validated, 15-item Mini Asthma Quality of Life questionnaire assessed activity limitations, symptom frequency and intensity, and emotional functioning to provide an asthma-related quality-of-life score.²⁰ Higher scores indicated a better quality of life.

Health Care Use

We assessed asthma-related health care use (emergency department [ED] visits, hospitalizations, scheduled office visits, urgent office visits, follow-up visits after an asthma attack) during the past 12 months through a series of self-reported items for the baseline and follow-up periods, which were verified with participants' medical records during corresponding periods. Self-reported ED visits and hospitalizations correlate significantly with health care records and provide a reliable assessment of these types of health care use.

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Treatment Plans

We asked participants whether they received a written asthma action plan from their physician and whether they negotiated their treatment plan with their physician.

Self-management Problems Related to Sex and Gender Roles

Sex and gender role-related queries were categorized into 7 rubrics related to symptoms and menstrual cycle, birth control, social and sexual activity, and asthma problems related to housework (vacuuming, dusting, or cooking), washing or cleaning products, fragrances, cosmetics, hair products, and exposures through child care.

Self-confidence and Self-regulation

Self-confidence for asthma management was measured using a scale composed of 15 items that has been used previously to assess a woman's perception of her ability to perform self-management tasks at home.²² To assess self-regulation ability, items from the Zimmerman scale²³ were used to determine asthma-related practices, including the use of peak flow monitoring. Items were summed to create a score for self-regulation, with higher scores indicating higher levels of self-regulation. Demographic and clinical data were also collected, including a depression score reflecting depressive symptoms measured on the Center for Epidemiologic Studies–Depression 8.²⁴

Statistical Analysis

A sample size calculation determined that 420 participants were needed at baseline (210 women in each treatment arm) using the primary study outcomes of ED visits and hospitalizations in a period of 12 months. Details of the sample size calculation are described in the study protocol article for this trial.¹³ At completion of data collection, a sample size of 318 women (or 76% retention rate), who completed all data collection sessions, was available for analysis.

Descriptive and bivariate data analyses (Fisher exact test and *t* test) were conducted to examine the baseline sample by randomization status. Descriptive statistics were used and between group differences (generalized estimating equation [GEE] models with logistic, Poisson, or Gaussian links) were examined to assess longitudinal change in outcome variables at baseline and 24-month follow-up for 3 groups: the control group, those who completed the entire intervention (6 sessions), and those who completed only part of the intervention (<6 sessions). Such preliminary analyses were based on dropout pattern stratification to examine differences between participants who completed the entire intervention during the 24-month follow-up and those who did not. GEEs were used to examine intervention group differences for each outcome variable, adjusting for confounding factors. Because several covariates were found to be associated with the chance of dropout, as well as the presence of intermittent missing data, the assumption of missing at random was used in the analysis. The method of inverse probability weighting was adopted to incorporate the chance of missingness in all GEE analyses. Each model included a binary time covariate, treatment variable (full intervention group, partial intervention group, control group), and interaction (treatment $\times$ time) to examine whether there was a different treatment effect at follow-up, as well as confounding covariates consisting of age, baseline body mass index, and baseline outcome responses for model adjustments. When the interaction is not significant, which is then removed from the model, the resulting main effect of intervention is interpreted as one that is consistent between time points. The PROC GENMOD procedure in SAS statistical software, version 9.4, and inverse probability weighting was used for the GEE model fitting. Statistical significance was based on a type 1 error level of $\alpha = 0.05$.

Results

Sample

Differences between those who completed the study and those who were lost to follow-up were observed in terms of age and income, with those lost to follow-up having a younger age ($P < .001$) and lower income ($P < .001$). One-third of participants who were lost to follow-up cited significant health and psychosocial issues as reasons for discontinuing the study. Table 2 gives the demographic, economic, and clinical characteristics among participants in the control and treatment groups. Mean (SD) age of the sample was 42.6 (14.99) years, 44% reported an annual household income less than \$20,000, and 32% reported having a college education or higher. The mean (SD) number of years living with asthma was 17.8 (14.1), and 30% reported not having well-controlled asthma. The mean (SD) number of comorbidities in this sample was 3.69 (2.62), the mean (SD) body mass

index was 33.50 (8.53), and the mean (SD) depression score was 7.19 (5.68). Frequently reported comorbidities included hypertension in 168 patients (40%), diabetes in 75 patients (17%), arthritis in 186 patients (44%), gastroesophageal reflux disease in 193 patients (46%), atopic dermatitis in 121 patients (29%), depression in 151 patients (36%), and anxiety in 141 patients (34%). No significant differences were evident at baseline between treatment and control group participants on all variables of interest.

Among those randomized to the intervention group, 62% completed all 6 intervention sessions, 7% completed 5 sessions, 1.5% completed 4 sessions, 4% completed 3 sessions, 8% completed 2 sessions, 7.5% completed 1 session, and 10% completed 0 sessions. Significant differences in dropout were evident by age ($P < .001$), household income ($P < .03$), number of comorbidities ($P < .01$), and frequency of nighttime symptoms ($P < .001$), with those who were younger, had lower incomes, had fewer comorbidities, and had more frequent nighttime symptoms more likely to drop out of the study.

Outcomes Between the Treatment and Control Groups

Table 3 gives the group differences between baseline and 24-month follow-up on all outcome variables of interest. Compared with the control group and partial intervention group, women who completed the full intervention had significant reductions between baseline and 24-month follow-up on daytime symptoms ($P < .05$), asthma control ($P < .01$), unscheduled physician visits ($P < .05$), and scheduled physician visits ($P < .01$). There were also differences between groups in noticing changes during their menstrual cycle ($P < .01$) and during child care activities ($P < .01$) and receiving an asthma action plan from their physician ($P < .05$). Women who completed the intervention reported greater self-regulation ($P < .01$) and improved quality of life ($P < .01$).

Changes in Symptoms, Asthma Control, Health Care Use, and Treatment Plans at 24-Month Follow-up Between the Treatment and Control Groups

Table 4 indicates that compared with the control group, those who completed the full intervention (6 sessions) had significant reductions in daytime symptoms (B estimate, -0.15 ; 95% CI, -0.27 to -0.03 ; $P < .01$) and asthma-related hospitalization (B estimate, 0.51 ; 95% CI, 0.00 – 1.02 ; $P < .05$) and improved asthma control (B estimate, 1.34 ; 95% CI, 0.57 to 2.12 ; $P < .001$) averaged during 24 months when adjusted for baseline measures.

Changes in Sex and Gender Role–Related Management Problems at 24-Month Follow-up Between the Treatment and Control Groups

Table 5 indicates that compared with the control group, those who completed the full intervention (6 sessions) had significant improvements in noticing changes related to their asthma during their menstrual cycle (B estimate, 1.42 ; 95% CI, 0.69 – 2.15 ; $P < .001$) and when having premenstrual syndrome (B estimate, 1.70 ; 95% CI, 0.67 – 2.72 ; $P < .001$) averaged during 24 months when adjusted for baseline measures.

Changes in Behavioral Outcomes at 24-Month Follow-up Between the Treatment and Control Groups

Table 6 lists the group differences between the treatment and control groups at follow-up on activity limitation, asthma-related quality of life, self-regulation, and self-confidence. Compared with the control group, those who completed the full intervention (6 sessions) had significant gains in self-regulation of their asthma (B estimate, 0.73; 95% CI, 0.17–1.30; $P < .01$) averaged during 24 months when adjusted for baseline measures.

Discussion

To our knowledge, this is the first study that assessed the long-term effect on health outcomes of a telephone-based asthma self-management program responsive to the cultural, sex, and gender needs of African American women. Our findings indicate that African American women who participated in the intervention and completed it in its entirety had greater improvements in self-regulation of their asthma compared with the control group, which manifested into improvements in asthma control, reductions in daytime symptoms and asthma-related hospitalization, and greater awareness of changes as a result of asthma during their menstrual cycle and when having premenstrual syndrome. On the basis of the NAEPP guidelines, asthma control is a key therapeutic goal,¹⁷ with improved control lowering risk for asthma exacerbations and minimizing need for urgent health care use.

The NAEPP expert guidelines on the diagnosis and management of asthma recommend that all patients receive an individualized written asthma action plan that details patient daily management (medications and environmental control strategies) and how to recognize and handle worsening asthma. An unexpected finding from our study was that at 24-month follow-up, slightly fewer individuals who completed the full intervention reported receiving an asthma action plan from their physician compared with the control and partial intervention groups. This finding needs to be further explored. We did not fully evaluate health care interactions after the intervention. Errors in self-reported recall may be one explanation for these differences. It may be that the partial intervention group received some benefits from the intervention in terms of advocating for an asthma action plan, and control groups were primed by just being involved in the study.

For the adapted program exclusively for African American women, differences were observed on key outcomes of interest between the treatment and control groups; however, neither group changed over time in outcomes. Several reasons may account for these findings. Approximately one-third of participants who were lost to follow-up reported significant health issues related to themselves and/or the care of a family member and personal problems (financial, psychosocial). Long-term disease management is embedded in the context of the home, work, and community environment. The ability to adequately self-manage chronic disease is significantly affected by the level and quality of support within these various social environments.²⁵ Many African American women with asthma, particularly those who are economically disadvantaged, may be at risk for poor asthma management given that they may be less likely than other adults to have the multiple sources of support that are known to contribute to optimal self-management and coping with chronic illness.²⁶ Given the resources necessary to provide a telephone-based counseling

intervention, including the amount of time involved, this does not appear to be a cost-effective manner to address asthma in African American women. Future efforts to design supportive resources to address the unique needs of African American women with asthma may consider multilevel approaches that provide broader supportive structures to facilitate self-management. Anecdotal evidence from participants at the 6-month follow-up session suggests considering the potential benefits of peer support among African American women as a way to sustain some of the benefits of the program in the long term.

The study population had significant morbidity, which may have also influenced seeing changes in outcomes over time between groups. Mean depression scores for the sample suggested clinically significant levels of psychological distress, and participants were managing a mean of approximately 4 other chronic conditions with asthma. Both depressive symptoms and the management of multiple morbidities are associated with poor adherence to asthma therapy and difficulties with self-management,^{27,28} which may require greater behavioral supports in the long term than what was available to participants in the intervention reported here. Participants may also prioritize a competing health condition above asthma, thus paying less attention to the role that asthma plays on symptoms, self-management, quality of life, and sex and gender role issues.

This study comprised African American women with asthma seeking care in Southeast Michigan to assess the effect on outcomes of an intervention specifically responsive to their sociocultural needs with asthma. As a result, findings of this trial may not be generalizable to African American women seeking care in other regions or to all groups. During recruitment, many potential participants could not be contacted because of change in telephone numbers or multiple unsuccessful call attempts. It is unclear how similar or different this group may be in terms of their asthma management compared with participants in this study. Given that this study aimed to measure functional, behavioral, and key historical clinical outcomes, specific physiologic parameters, such as forced expiratory volume in 1 second assessment via spirometry, were not measured, although this information would be useful for future studies. ACT scores also reflect asthma scores during the previous 4 weeks, can be affected by many factors, and may not account for seasonal differences.

African American women who completed a telephone-based self-management program responsive to sociocultural and sex and gender issues had significant improvements in asthma control, asthma-related hospitalizations, self-regulation of asthma management, awareness of the effect of asthma on menstrual processes, and reduced asthma symptoms compared with the control group. However, neither group changed over time in outcomes. Self-management education that considers the unique challenges of African American women has implications for clinical practice in terms of ability to enhance greater disease control. Future work should consider greater emphasis in addressing significant comorbidities and psychosocial issues alongside asthma management to realize improved asthma outcomes among African American women in the long term.

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Figure 1.
Consort flow diagram.

Table 1

Overview of the Intervention and Cultural Enhancements

Session and enhancements	Topics addressed
Session 1	Tracking symptoms and triggers; experience using the peak flow meter
Session 2	Review symptom diary
Session 3	Review symptom diary; identify an asthma management goal and develop plan to achieve goal
Session 4	Review progress toward goal and adjust plan as needed; make new goals if goal achieved; discuss reward and benchmarks of progress
Session 5	Review progress toward goal and adjust plan as needed; make new goals if goal achieved; discuss reward and benchmarks of progress
Session 6	Booster session: review problem solving steps; review step-by-step plan to see if participant has accomplished goal; gain insight into how participant is using the problem-solving steps
Culturally responsive enhancements to Women Breath Free Intervention counselors	To enhance rapport with participants, intervention counselors are African American women
Workbook content	Images in the workbook represent a diversity of African American women and families Integrating the role of social and cultural spaces (eg, church, family, and so on) to discuss potential triggers and asthma management problems or supports
Counseling sessions	Culturally linked factors addressed by telephone counselors during program sessions.

Table 2Demographic and Clinical Characteristics of Participants in the Control and Treatment Groups^a

Characteristic	Control group (n = 210)	Treatment group (n = 212)	P value ^b
Age, mean (SD), y	43.35 (15.23)	42.01 (14.76)	.36
Married	59 (29)	61 (29)	.92
Head of household	139 (67)	143 (68)	.94
Educational attainment			.46
High school or GED or less	42 (20)	42 (20)	
Some college, associate's degree, or vocational school	93 (45)	107 (51)	
College or above	71 (35)	62 (29)	
Employed	135 (65)	144 (68)	.46
Household income, \$			.77
<20,000	90 (46)	83 (42)	
20,001–40,000	50 (26)	53 (26)	
40,001–60,000	24 (12)	26 (13)	
>60,001	30 (16)	37 (19)	
Health insurance			.53
No insurance	9 (4)	8 (4)	
Private	83 (40)	100 (47)	
Medicare only	2 (1)	2 (1)	
Medicare and supplemental coverage	40 (19)	38 (18)	
Medicaid only	55 (26)	52 (25)	
Other government	21 (10)	14 (7)	
Receives specialty care	68 (32)	83 (40)	.12
Time since asthma diagnosis, mean (SD), y	17.87 (15.35)	17.79 (13.0)	.95
Frequency of daytime symptoms			.99
<2 days per week	132 (63)	133 (63)	
3 days per week	56 (27)	57 (27)	
Throughout the day	22 (10)	22 (10)	
Asthma control (NAEPP categories)			.91
Well controlled	63 (30)	67 (32)	
Not well controlled	64 (30)	65 (31)	
Very poorly controlled	83 (40)	80 (38)	
ACT score, mean (SD)	16.94 (4.33)	16.94 (4.58)	.99
Asthma medications			.89
Controller	144 (69)	150 (71)	
Rescue only	46 (22)	43 (20)	
Other	18 (9)	19 (9)	
Total No. of other chronic conditions, mean (SD)	3.43 (2.52)	3.95 (2.69)	.32
BMI, mean (SD)	33.63 (8.90)	33.36 (8.17)	.74
Social support score, mean (SD)	2.67 (1.06)	2.70 (1.05)	.75
Depression score, mean, (SD)	6.91 (5.83)	7.47 (5.53)	.31

Characteristic	Control group (n = 210)	Treatment group (n = 212)	P value ^b
Asthma-related quality of life score, mean (SD)	4.86 (1.15)	4.86 (1.28)	.93

Abbreviations: ACT, Asthma Control Test; BMI, body mass index; GED, General Educational Development; NAEPP, National Asthma Education and Prevention Program.

^aData are presented as number (percentage) of patients unless otherwise indicated.

^bThe Fisher exact test was used to examine the association of categorical variables with treatment group, and the *t* test was used to differences for continuous variables between the treatment and control groups.

Table 3Group Differences Between Baseline and 24-Month Follow-up on Key Outcomes^a

Outcome variable	Control	Partial intervention	Full intervention	P value
2 Nights with nighttime symptoms per week				
Baseline	85 (40)	44 (55)	50 (38)	.01
24-Month follow-up	50 (29)	9 (35)	29 (24)	.18
3 Days of daytime symptoms per week				
Baseline	78 (38)	35 (43)	44 (33)	.42
24-Month follow-up	59 (34)	10 (38)	30 (26)	.02
ACT score, mean (SD)				
Baseline	16.94 (4.33) (n = 210)	16.53 (4.85) (n = 81)	17.20 (4.41) (n = 131)	.23
24-Month follow-up	18.01 (4.66) (n = 172)	17.68 (4.83) (n = 25)	19.59 (4.40) (n = 118)	.01
Annual No. of ED visits, mean (SD)				
Baseline	1.00 (1.87) (n = 209)	0.91 (1.34) (n = 81)	0.83(1.34) (n = 131)	.27
24-Month follow-up	0.64(1.46) (n = 171)	0.92 (1.32) (n = 25)	0.51 (1.23) (n = 118)	.07
Annual No. of unscheduled physician visits, mean (SD)				
Baseline	1.69 (2.53) (n = 208)	1.51 (1.69) (n = 79)	1.60 (2.11) (n = 131)	.41
24-Month follow-up	1.18 (1.90) (n = 171)	1.00 (1.22) (n = 25)	0.80(1.66) (n = 118)	.05
Annual No. of scheduled physician visits, mean (SD)				
Baseline	2.26 (2.57) (n = 207)	2.39 (2.34) (n = 81)	2.52 (4.89) (n = 131)	.46
24-Month follow-up	1.81 (3.44) (n = 170)	1.20 (1.21) (n = 24)	2.49 (5.50) (n = 118)	.01
Annual No. of follow-up visits for an asthma attack, mean (SD)				
Baseline	1.61 (2.41) (n = 207)	1.56 (1.69) (n = 80)	1.47 (1.93) (n = 131)	.44
24-Month follow-up	1.11 (1.51) (n = 170)	0.76 (0.96) (n = 25)	0.92(1.84) (n = 117)	.09
Annual No. of hospitalizations, mean (SD)				
Baseline	0.29 (0.88) (n = 209)	0.21 (0.54) (n = 80)	0.32 (0.75) (n = 131)	.17
24-Month follow-up	0.19 (0.72) (n = 171)	0.28 (0.61) (n = 25)	0.22 (0.77) (n = 118)	.40
Activity limitation, No. (%)				
Baseline	127 (66)	58 (73)	75 (58)	.02
24-Month follow-up	94 (54)	16(61)	57 (48)	.11
Overall self-regulation score, mean (SD)				
Baseline	9.19 (3.41) (n = 209)	9.11 (3.89) (n = 81)	9.52 (3.53) (n = 131)	.31
24-Month follow-up	9.99 (3.47) (n = 170)	10.80 (2.25) (n = 25)	10.80 (3.01) (n = 117)	.01
Overall quality-of-life score, mean (SD)				
Baseline	4.86 (1.15) (n = 209)	4.62(1.30) (n = 81)	5.01 (1.25) (n = 131)	.02
24-Month follow-up	5.18 (1.21) (n = 171)	4.94 (1.22) (n = 25)	5.45(1.24) (n = 117)	.01
Overall self-confidence score, mean (SD)				
Baseline	11.42 (3.26) (n = 209)	10.70 (3.63) (n = 81)	11.51 (3.09) (n = 131)	.04
24-Month follow-up	12.39 (3.01) (n = 170)	12.12 (2.84) (n = 25)	12.75 (2.72) (n = 116)	.15
Noticed changes during menstrual cycle				
Baseline	12(6)	5 (6)	6 (5)	.53
24-Month follow-up	8 (4)	3 (11)	14 (12)	.01

Outcome variable	Control	Partial intervention	Full intervention	P value
Noticed changes when having PMS				
Baseline	9 (4)	3 (4)	6 (5)	.69
24-Month follow-up	4 (2)	2 (8)	6 (5)	.10
Noticed changes since start of taking birth control				
Baseline	1 (1)	2 (2)	4 (3)	.06
24-Month follow-up	1 (1)	0 (0)	1 (1)	NA
Bothered by asthma during sexual activities				
Baseline	35 (19)	9 (14)	18 (16)	.21
24-Month follow-up	23 (16)	5 (21)	14 (12)	.17
Noticed changes when using cosmetics				
Baseline	21 (12)	17 (23)	17 (15)	.48
24-Month follow-up	21 (14)	4 (19)	16 (16)	.09
Noticed changes when using fragrances				
Baseline	133 (64)	54 (68)	86 (66)	.46
24-Month follow-up	108 (65)	13 (57)	63 (55)	.06
Noticed changes during child care activities				
Baseline	35 (22)	17 (28)	23 (24)	.25
24-Month follow-up	30 (22)	5 (25)	9 (9)	.01
Asthma action plan				
Baseline	131 (64)	59 (74)	85 (65)	.07
24-Month follow-up	111 (66)	21 (84)	74 (64)	.03
Negotiated plan with physician				
Baseline	95 (72)	41 (69)	57 (68)	.42
24-Month follow-up	78 (70)	13 (62)	51 (69)	.40

Abbreviations: ACT, Asthma Control Test; ED, emergency department; NA, not applicable (*P* value could not be generated because of low cell count); PMS, premenstrual syndrome.

^aData are presented as number (percentage) of patients unless otherwise indicated. Generalized estimating equation models with logistic, Poisson, and Gaussian links are fitted for binomial, count, and continuous outcome variables for each time point to test whether differences among treatment groups exist. Records with missing data were removed.

Table 4Effect of the Intervention on Symptoms, Asthma Control, Health Care Use, and Treatment Plans at 24-Month Follow-up^a

Variable	Time		Partial intervention group (Session count <6)		Full intervention group (Session count = 6)	
	B estimate (95% CI)	P value	B estimate (95% CI)	P value	B estimate (95% CI)	P value
Nighttime symptoms	-0.10 (-0.19 to -0.01)	.03	0.14 (-0.05 to 0.32)	.14	-0.07 (-0.19 to 0.04)	.21
Daytime symptoms	0.04 (-0.06 to 0.13)	.45	0.13 (-0.06 to 0.32)	.18	-0.15 (-0.27 to -0.03)	.01
Asthma control	0.33 (-0.15 to 0.81)	.18	-0.88 (-2.09 to 0.33)	.15	1.34 (0.57 to 2.12)	<.001
Hospitalization	-0.13 (-0.38 to 0.11)	.29	0.60 (-0.21 to 1.42)	.14	0.51 (0.00 to 1.02)	.05
ED visits	-0.02 (-0.22 to 0.17)	.81	0.34 (-0.21 to 0.89)	.23	0.09 (-0.30 to 0.48)	.64
Unscheduled physician visits	-0.28 (-0.48 to -0.09)	.004	-0.07 (-0.63 to 0.50)	.82	0.06 (-0.28 to 0.39)	.74
Scheduled physician visits	-0.15 (-0.30 to 0.00)	.05	-0.14 (-0.54 to 0.26)	.50	0.01 (-0.22 to 0.25)	.92
Follow-up visits for an attack	-0.19 (-0.37 to -0.01)	.04	-0.17 (-0.71 to 0.37)	.53	0.07 (-0.24 to 0.38)	.66
Asthma action plan	0.03 (-0.31 to 0.36)	.87	0.07 (-0.68 to 0.82)	.86	-0.24 (-0.68 to 0.21)	.30
Negotiated plan with physician	0.31 (-0.20 to 0.81)	.23	-0.52 (-1.35 to 0.30)	.21	0.30 (-0.35 to 0.94)	.37

Abbreviations: CI, confidence interval; ED, emergency department.

^aModels adjusted for age, baseline body mass index, and baseline responses to outcomes.

Effect of the Intervention on Sex and Gender Role–Related Management at 24-Month Follow-up^a

Table 5

Variable	Time			Partial intervention group (Session count <6)			Full intervention group (Session count = 6)		
	B estimate	(95% CI)	P value	B estimate	(95% CI)	P value	B estimate	(95% CI)	P value
Noticed changes during menstrual cycle	0.19	(−0.17 to 0.55)	.30	0.13	(−1.12 to 1.38)	.83	1.42	(0.69 to 2.15)	.001
Noticed changes when having PMS	0.11	(−0.52 to 0.76)	.72	0.91	(−0.60 to 2.42)	.24	1.70	(0.67 to 2.72)	.001
Noticed changes since start of taking birth control	−0.89	(−1.90 to 0.13)	.09	−0.15	(−5.1 to 0.72)	.99	−0.05	(−0.99 to 0.89)	.92
Bothered by asthma during sexual activities	0.03	(−0.08 to 0.14)	.62	0.16	(−0.10 to 0.41)	.24	−0.06	(−0.22 to 0.11)	.50
Bothered by asthma when using fragrances	−0.08	(−0.21 to 0.04)	.19	−0.04	(−0.37 to 0.29)	.80	−0.07	(−0.28 to 0.14)	.51
Bothered by asthma when using cosmetics	−0.05	(−0.17 to 0.08)	.45	0.17	(−0.11 to 0.44)	.24	0.11	(−0.07 to 0.28)	.23
Bothered by asthma during child care activities	−0.14	(−0.31 to 0.03)	.10	0.10	(−0.24 to 0.44)	.57	−0.16	(−0.37 to 0.06)	.15

Abbreviations. CI, confidence interval; PMS, premenstrual syndrome.

^aModels adjusted for age, baseline body mass index, and baseline responses to outcomes.

Table 6

Effect of the Intervention on Behavioral Outcomes at 24-Month Follow-up^a

Variable	Time		Partial intervention group (Session Count <6)		Full intervention group (Session Count = 6)	
	B estimate (95% CI)	P value	B estimate (95% CI)	P value	B estimate (95% CI)	P value
Activity limitation	-0.04 (-0.12 to 0.05)	.36	0.11 (-0.07 to 0.29)	.25	-0.07 (-0.18 to 0.04)	.22
Quality of life	0.14 (0.03 to 0.26)	.02	-0.10 (-0.41 to 0.22)	.55	0.19 (-0.02 to 0.39)	.07
Self-regulation	0.43 (-0.03 to 0.90)	.07	-0.41 (-1.31 to 0.50)	.38	0.73 (0.17 to 1.30)	.01
Self-confidence	0.29 (-0.09 to 0.67)	.14	-0.57 (-1.35 to 0.20)	.15	0.41 (-0.07 to 0.90)	.09

Abbreviation: CI, confidence interval.

^aModels adjusted for age, baseline body mass index, and baseline responses to outcomes.