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From the Female Perspective: Long Term Effects on Quality of Life of a Program for Women with Asthma

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Abstract

Introduction—Among adults, asthma predominates in women. Only recently have sex and gender role influences on asthma been studied and only one study has focused on asthma management by women with the condition. That investigation showed that one year subsequent to an intervention addressing sex and gender role factors, women's asthma status improved. This paper presents data from the two year follow-up to determine if there were longer term effects of the intervention on the quality of life and asthma status of the participants.

Methods—A randomized controlled design was used with 808 female patients with asthma assigned to a control group or a female-oriented intervention that focused on particular management challenges related to sex and gender role factors. Data were collected at baseline and two years post intervention by telephone interview and review of medical records. Measures included asthma related quality of life (QoL), health care and medicine use for asthma, level of self regulation, confidence to manage the condition, sex and gender role related asthma problems, and days of missed work or school because of asthma. Data were analyzed using both GEE logistic and log linear regression.

Results—Despite randomization, intervention group women had more persistent asthma at baseline. At two years, no significant health care use differences were evident. However, intervention women had significantly greater decrease of asthma symptoms with sexual activities ($p=0.01$) and greater annual reduction in days missed work for asthma in winter months ($p=0.03$) were bothered significantly less by asthma symptoms during sexual activity ($p=0.01$), missed fewer days of work for asthma in the winter months ($p=0.03$), had greater important in regulating ($p=0.01$) confident to manage asthma ($p=0.01$), and had higher levels of asthma related QoL ($p=0.02$). They also had greater reduction in administrations of short term beta agonists ($p=0.05$) i.e. rescue medicines.

Conclusion—An intervention focused on female-specific aspects of asthma management can result in improved health status and QoL for women with asthma evident two years post intervention.

Keywords

Asthma; Women; Gender; Telephone Counseling

Introduction

Asthma in women is a significant clinical and public health problem. In early adolescence, asthma shifts from a disease predominant in boys to a condition more prevalent in girls and women.¹ The shift appears to be hormone related.² Subsequently, women bear a higher burden of asthma morbidity and mortality and have higher rates of health care use for the disease.³ Studies suggest sex and gender role factors affecting asthma include: cyclic hormonal changes, estrogen replacement therapy, birth control use, pregnancy, menopause, performing various household tasks that expose them to precipitants of symptoms, and more frequent exposure to certain fragrance or cosmetic related environmental triggers.^{3,4,5} Clinicians rarely discuss these sex and gender role related management challenges with women, although women appear to notice and be concerned about such challenges including symptoms during sexual activity.⁶

In only one asthma management intervention study known to the investigators have female sex and gender role related factors been addressed.⁶ Evaluation illustrated that one year subsequent to participation in a program providing the female perspective on management challenges and including attention to sex and gender role factors, women experienced fewer asthma related night time symptoms, less health care use, fewer days of missed school or work, and fewer asthma problems related to their sex and gender roles. This paper examines the longer term benefits of this intervention. The study hypotheses were that as sex and gender role related issues are less attended to in conventional asthma treatment and education, women who had had the advantage of these as a focus of an intervention would reap benefits. Specifically, compared to a control group, intervention women would realize a better symptom profile, better health care use, quality of life, sex and gender role related management, self regulation and confidence to manage asthma up to two years post randomization. They would also use medicines more appropriately i.e. as recommended in the National Asthma Education and Prevention Program (NAEPP) guidelines.⁷

Methods

Study Design and Sample

The randomized controlled study involved 808 women, who met study criteria, were receiving services at the University of Michigan Health System (UMHS) and were identified through the UMHS data warehouse (a system wide mechanism to facilitate research and monitor consent). All study procedures were approved by the University of Michigan Institutional Review Board. Patients were randomly assigned to an intervention group or a usual care group. "Usual care" within the University system comprises treatment based on National Asthma Education Prevention Program (NAEPP) guidelines⁷ for the diagnosis and treatment of asthma as well as telephone follow-up for purposes of patient monitoring. Asthma education is provided at the time of the clinic visit and is similar to that found in most health care institutions, specifically, it does not emphasize sex and gender role factors in asthma management by female patients. Criteria for recruitment of study participants were: 1) 18 years of age or older; 2) diagnosis of asthma by a UMHS physician; 3) presence of active asthma symptoms in the past 12 months; 4) enrolled as a patient in one of the participating asthma-related clinics, 5) no extenuating medical or mental conditions (i.e., terminal illness, dementia); 6) not pregnant (women who became pregnant during the study continued participation but their data were excluded from analyses); and 7) access to a telephone. A total of 2,336 women were sent study invitation letters and refusal postcards during the three-and-one-half-year recruitment period (see Figure 1). Women who did not return the postcard were contacted by telephone. Consent forms were mailed to 997 women who agreed to participate when telephone contact was made. Ultimately, 808 respondents returned the completed consent forms by mail and provided data at baseline. The women

were randomized on a 1 to 3 ratio into either the female focused intervention or a usual care control group to account for any burden of participation and potential associated attrition. Participants' physicians were blind to the assignment of their patients in the study. At the second follow-up time point, (24 months post randomization), 580 women completed data collection. The attrition rates were 25% from baseline (n=808) to the first follow-up (12 months subsequent to randomization) and 5% from the first follow-up (n=608) to the second follow-up (n=580) at 24 months post randomization.

The Intervention

The intervention was a multiple-component intervention entitled, "Women Breathe Free" (WBF) delivered by a nurse health educator through telephone counseling. Women in the intervention group were introduced to a self-regulatory, problem-solving process to be undertaken in accordance with the patient's therapeutic plan and her physician's recommendations.⁸ Telephone counseling used standardized protocols and was tailored to the woman's level of self-regulation.⁹ Women's specific asthma problems were addressed, as were the particular concerns of the women in managing these aspects of their condition uncovered in baseline data collection and through counseling conversations. Participants were encouraged to use the program process to study the range of factors affecting their asthma, including the potential effects of their sex and gender roles, e.g. menses, use of estrogen replacement therapy (ERT), premenstrual symptoms (PMS), sexual activity, housecleaning, etc. Each woman selected a focus for her problem solving based on the clinical recommendations of her physician. Materials comprising an educational kit to help in problem solving were sent to her at home.

Measures & Data Collection

Data were collected by telephone interview at baseline, prior to randomization, and one and two years subsequent to randomization. Data collectors were blind to the assignment of the woman to the study arms.

Symptom experience information was collected through items used in previous studies¹⁰ that mimic clinicians' questions during history taking. These conformed to NAEPP Guidelines for assessing asthma symptoms and accounted for seasonality of asthma⁷. Medicine-use concerning six categories of asthma drugs based on NAEPP Guidelines were assessed through series of items related to type and frequency of use.

Measures also included the number of hospitalizations, emergency department (ED) visits, unscheduled urgent visits to a clinic, and scheduled clinic visits for asthma in the past 12 months assessed through a series of self report items. To further verify the accuracy and reliability of the self-reports of asthma health care use, medical record data for asthma ED visits and hospitalizations from the U-M Data Warehouse for a random sample of 17% of women were reviewed to examine the correlations between the two sources of data at baseline and follow-up. Pearson Correlation Coefficient analysis illustrated that self-reported ED visits and hospitalizations were significantly correlated with medical report data ($R > 0.56$ to < 0.6) at each time point.

Sex and gender role related items assessed symptoms during the menstrual cycle and PMS, use of birth control pills or ERT, and urinary incontinence. Items also tapped asthma problems related to housework often undertaken by women (vacuuming, dusting, cooking), use of washing or cleaning products, fragrances, cosmetics, and hair products, exposures through child care, and symptoms associated with social and sexual activity.

Juniper's Mini Asthma Quality of Life Questionnaire^{11,12} was used to measure a woman's asthma related quality of life. The Mini Asthma Quality of Life Questionnaire clusters items

into four domains: 1) activity limitations, 2) symptoms, 3) emotional function, and 4) environmental stimuli. The main variable of interest was the mean overall score for quality of life. A scale of self-confidence for asthma management comprised items previously used by the investigators to assess the woman's perception of her ability to carry out management tasks at home.¹³ To assess the level or phase of a woman's self-regulation ability, items from Zimmerman's scale¹⁴ were used to determine asthma-related practices, including use of peak flow monitoring (PFM). Medication use, specifically, anti inflammatory therapies and beta agonists was assessed through questionnaire items. Demographic data including height and weight [Body Mass Index (BMI)] were also collected and served as covariates in statistical models.

Data Analyses

Analyses tested the a priori assumptions regarding the areas where initial positive outcomes had been anticipated for patients, that is improvements in daytime and nighttime symptoms, absenteeism from work or school, symptoms during sexual activity, quality of life, self regulation of asthma, self confidence to manage asthma, use of peak flow monitoring, and medicine use. Sample size calculations using health care use as the primary dependent variable determined that a final sample of 520 was needed to achieve 80% power at the 95% confidence level. A sample of this magnitude would allow testing of other study outcomes with a similar or higher level of confidence. Sufficient data (n=608, 580) for study women were available to analysis at the 12 and 24 month time periods.

To account for the longitudinal nature of the study and overall 28% drop rate from baseline to the second follow-up, a rate not unusual and observed in similar studies,^{15, 16} analysis of the hypotheses utilized linear mixed models to assess continuous outcome variables, generalized mixed models for binary variables and Poisson distributed outcomes analysis.¹⁷ Mixed modeling used all the data available at baseline (n=808), and first (n=608), and second follow-up (n=580). Estimations and inferences were unbiased and valid under the missing at random assumption.¹⁸ All women (n=424) who were randomly assigned to the treatment group (intent-to-treat) were included in data analysis. SAS proc mixed was used for continuous outcome variables and SAS macro glimmix (can be reviewed at <http://support.sas.com/ctx/samples/index.jsp>) for count and binary variables.¹⁹ In all analyses, baseline values were controlled.

The final model was also adjusted for baseline age and persistent asthma according to NAEPP classification because in preliminary models these were significantly associated with outcomes of interest. Generalized estimation equations (GEE) was employed to account for any clustering or skewness in the data. Women in the treatment group at baseline, despite randomization had more persistent asthma than women in the control group. Education, ethnicity, income, marital status, employment, and baseline body mass index (BMI, defined as weight in kilograms divided by height in meters squared) were all considered as potential cofounders and separately examined. BMI, ethnicity, and income were found to be significantly associated with outcomes and highly correlated to each other. To avoid multi co linearity, only BMI was included in the final model. Estimated regression co-efficients and the corresponding P value are presented. A P value of less than 0.05 was considered significant.

Hospitalization was an exceptional variable. Most of the women (90% at baseline and 94% follow-up) reported no hospital admissions and Poisson analysis is not appropriate in such situation.¹⁷ Therefore assessment of hospitalization used only the subgroup of women who had at least had one hospitalization at baseline and/or at follow-up. Baseline to first and second follow-up difference are presented in the appendix.

Results

The demographic characteristics are presented in Table I.⁶ The mean age of participants in the treatment group was 48.2 years (SD=13.1) and 48.7 (SD=14.3) in the control group. The percent of minority participants in the treatment group was 15.8% and 16.3% in the control group. The percent of participants who obtained a high school education or less in the treatment and control group was 28.3% and 32.4% respectively. In the treatment group, 64.6% of participants were married and 60.3% were married in the control group. The percent employed in the treatment group was 64.8% and 67.5% in the control group. No differences in variables related to health care use were observed.

Table II shows that at the second follow-up time point there was a marginal but not significantly greater reduction for program women in the average number of nights in the winter months when symptoms were experienced (estimate -1.19, $p=0.08$). Symptoms at night are a marker for more serious asthma. At the first follow-up time point greater reduction in the fall and annually were noted. There were no differences in daytime symptoms at the first and second follow-up.

Table III indicates that at the second follow-up time point, compared to controls, women in the treatment group had significantly greater reduction for days of missed work or school in the winter months because of asthma (estimate 1.56, $p=0.03$). At the first time point they had marginally greater reductions in the winter and annually.

Table IV indicates that at both the first and the second follow-up time point, women in the treatment group reported a greater reduction of bother from symptoms of asthma during sexual activity compared to controls (estimate -0.69, $p=0.01$). Table IV also shows that at the second follow-up time point, women in treatment group continued to have significantly greater improvement than controls related quality of life (estimate 0.17, $p=0.02$), self-regulation (estimate 0.32, $p=0.01$), and self-confidence to manage asthma (estimate 0.35, $p=0.01$).

Table V illustrates that over time, women in the treatment group compared to controls reported a significantly greater increase of peak flow meter use to monitor the most recent asthma attack (estimate 0.44, $p=0.03$) but routine use of peak flow monitoring (PFM) was no different than controls.

Table VI describes medication use. Although no changes were observed at the first follow-up, at the second time point, women in the treatment group had a significant reduction in use of short-acting inhaled bronchodilators, that is, rescue medicine compared to controls (estimate -0.59, $p=0.05$).

Table VII provides a summary of changes in key outcome variables from the first and second follow-up in the treatment group compared to controls.

Discussion

The intervention evaluated was designed to take into account the woman's perspective and the female experience in managing asthma. Its focus was helping women to understand how sex related factors might affect her condition including hormonal shifts and sexual activity. It also focused on how her condition may be affected by her gender roles, that is, from undertaking tasks that expose her to precipitants of symptoms e.g. cooking, cleaning the house, caring for children etc. Several results of the intervention from first to second follow-up were durable indicated by no changes in significant difference between groups from

follow up one to two. Indeed, on three variables women did better over the longer term while on three, differences from control were not durable.

Reductions in annual frequency of asthma symptoms were no longer evident but in winter months treatment women continued to do better compared to controls. In a difficult season for asthma, treatment women had their condition under somewhat better control. In another measure of symptoms, days of missed school or work in the winter months, treatment women actually improved their results by the two year time point moving to significant statistical differences from controls. Fewer symptoms during sexual activity were a durable outcome with differences noted at both time points. These outcomes must be considered in light of the fact that at baseline intervention women had more serious asthma than women in the control group making the case for intervention more difficult to demonstrate. The question of clinical versus statistical significance arises with asthma symptom related findings. How important are one or two days without symptoms to a woman? One way to think about this issue is to consider national guidelines for diagnosis and treatment for asthma. For example, in the NAEPP guidelines⁷ in the U.S., two symptom days can represent the difference between patients considered to have their asthma under control versus not in control. Although some differences in this study do not appear to be great, they were likely important to participants and contributed to their reports that the quality of their lives improved post intervention. Symptom bother during sexual activity was based on women's self report and why they experienced less trouble is not fully explained in these data. It may have been simply that there were fewer asthma symptoms experienced, or this perception could have been influenced by women's greater sense of confidence to manage asthma and/or the higher level of asthma self regulation skills they used post program.

Use of peak flow monitoring when managing an attack actually improved by the two year time point distinguishing treatment and control women. The normative behavior among asthma patients is not to use peak flow monitoring,²⁰ and studies have shown patients to be forthcoming in their reports of use. Although there were no differences in frequency of monitoring, in this study between treatment and control groups, treatment women were significantly more likely to have monitored the last asthma attack using PFM. Studies have shown that use of PFM declines steadily over time.^{20,21,22} Increasingly, efforts to use PFM strategically and for learning about one's asthma (as opposed to daily use) have been suggested as important in reducing the burden of management on patients. Intervention women appear to have used PFM in this way more their control peers.

Medicine use actually improved for treatment women over time. They became less dependent on short term bronchodilators by the 24 month time period. Over use of beta agonists is an unhelpful and unsafe practice. Health care use differences seen at first follow-up were no longer evident between groups. Lack of differences in utilization may be, in part, attributable to the fact that women in the treatment group who initially had more persistent asthma were by the second time point doing better regarding symptoms and had less need for such services. The less frequent use of short term bronchodilators by these women supports this supposition.

Long term outcomes regarding a woman's asthma related quality of life, level of self-regulation, and confidence to carry out day to day asthma management tasks were durable or emerged by the second follow-up period. Confidence has been associated with more effort to continue behaviors such as those involved in disease management.²³ It may be that learning a problem solving process and developing greater confidence combined with fewer symptoms contributed to a sustained higher level of quality of life for treatment women. The study made evident that an important element of functioning, sexual activity, continued to

give rise to fewer problems with asthma symptoms. As noted, this result also may have improved overall quality of life.

The intervention is the first, to the knowledge of the researchers, to document over the long term the extent and importance to women of helping them to consider that the fact they are women will itself influence the way in which they must manage their asthma. Perhaps the durability of a number of important outcomes occurred, because the program was novel in the experience of the women, had a decidedly female tone, dealt with issues not usually handled in conventional asthma treatment and education programs, provided a new perspective and gave somewhat sensitive information needed by the participants not easily accessible elsewhere.

Conclusion

A female oriented program focusing on particular management issues for women including sex and gender role related factors was shown to produce benefits up to two years post intervention. Focus on female specific challenges in asthma management deserves attention in clinical consultations, education, and research.

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Appendix

Mean/Frequency and Difference between Baseline and Follow-up II

Outcome Variables		Group	Baseline		Follow-Up II		The difference between Follow-up II and Baseline	
			Mean	SD*	Mean		Mean	SD*
Symptoms	Yearly average nights of nighttime symptoms per month	control	3.9	6.3	3.1	5.9	- 0.77	6.1
		treatment	5.1	7.2	3.7	6.8	- 1.42	7.0
	Yearly average days of daytime symptoms per month	control	8.5	8.7	7.1	8.2	- 1.32	8.5
		treatment	8.7	9.2	8.0	9.3	- 0.70	8.9
Health Care Use	Yearly average number of ED visits	control	0.5	1.8	0.2	0.6	- 0.29	1.5
		treatment	0.6	1.6	0.2	0.8	- 0.37	1.3
	Yearly average number of unscheduled doctor visits	control	0.8	1.6	0.6	1.3	- 0.26	1.5
		treatment	1.3	2.8	0.6	1.4	- 0.65	2.3
	Yearly average number of scheduled doctor visits	control	2.1	2.8	2.2	4.2	0.10	3.4
		treatment	2.6	3.9	2.4	3.5	- 0.22	3.7

Outcome Variables		Group	Baseline		Follow-Up II		The difference between Follow-up II and Baseline	
			Mean	SD *	Mean		Mean	SD *
	Yearly average number of follow-up visits for an attack	control	0.9	1.7	0.9	3.9	- 0.03	2.7
		treatment	1.6	3.2	0.8	2.3	- 0.82	2.9
	Yearly average number of hospitalizations	control	0.2	1.0	0.1	0.5	- 0.09	0.9
		treatment	0.3	1.2	0.1	0.7	- 0.17	1.0
Absence	Yearly average days missed work per month	control	2.3	6.3	2.0	6.4	- 0.31	6.4
		treatment	2.9	6.3	2.2	6.8	- 0.74	6.5
Quality of life	Overall mean score of quality of life	control	2.1	0.8	2.0	0.9	- 0.12	0.9
		treatment	2.4	0.9	2.1	1.0	- 0.29	1.0
Self-regulation	Overall mean score of self-regulation	control	5.8	2.5	5.9	2.5	0.12	2.5
		treatment	6.1	2.3	6.3	2.3	0.21	2.3
Self-confidence	Overall mean score of self-confidence	control	8.0	1.6	8.0	1.7	0.01	1.6
		treatment	7.8	1.6	8.2	1.5	0.40	1.5
Gender-specific problems	% noticed changes during menstrual cycle	control	12.2		13.9		1.7	
		treatment	14.7		23.2		8.5	
	% noticed changes when having PMS	control	14.2		15.9		1.7	
		treatment	15.8		17.2		1.4	
	% bothered by asthma during sexual activities	control	15.1		12.9		- 2.2	
		treatment	22.9		12.9		- 10.0	
Peak flow meter	% general use of peak flow meter	control	10.5		7.7		- 2.8	
		treatment	15.1		14.1		- 1.0	
	% used peak flow meter to monitor last attack	control	24.3		27.8		3.5	
		treatment	27.3		36.9		9.6	

* standard deviation

Abbreviations

ED

Emergency department

GEE	Generalized estimate equation
UMHS	University of Michigan Health System
NAEPP	National Asthma Education Prevention Program
ERT	Estrogen Replacement Therapy
PMS	Premenstrual symptoms
BMI	Body mass index
PFM	Peak Flow Monitoring

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Figure 1.
Study Participation

Table I

Comparisons between Treatment and Control Groups at Baseline*

Variables	Control Group	Treatment Group	P value
Age, yr	48.7 (14.3)	48.2 (13.1)	0.72
Annual household income < \$20,000	13.8%	13.7%	0.97
Minority	16.3%	15.8%	0.85
Education high school or less	32.4%	28.3%	0.21
Married	60.3%	64.6%	0.21
Employed	67.5%	64.8%	0.42
BMI	29.4 (7.7)	30.2 (8.4)	0.15
From specialty clinics	32.0%	34.9%	0.39
Asthma Severity			
Mild intermittent	56.0%	48.5%	0.10
Mild persistent	13.5%	16.8%	0.21
Moderate persistent	17.7%	21.5%	0.20
Severe persistent	12.8%	13.2%	0.45
Total Persistent asthma	44.0%	51.5%	0.03
Medicine Use			
Inhaled corticosteroids	58.9%	55.2%	0.21
Oral cortico steroids	8.3%	12.0%	0.22
Inhaled non-steroidal	2.6%	2.6%	0.99
Anti-leukotrienes	32.3%	35.6%	0.56
Long-acting bronchodilators	33.3%	31.1%	0.50
Short-acting inhaled	87.0%	90.3%	0.13
Herbal/remedies	58.9%	55.2%	0.39

* Values are given as the mean (SD) or %, unless otherwise indicated.

Nighttime Asthma Symptoms

Table II

Average # of nights in a month		Age	Baseline BMI	FU ₁	FU ₂	Treat	Treat*FU ₁	Treat*FU ₂
Spring	estimate:	0.01	0.12	-1.41	-0.97	0.98	-0.17	-0.29
	p-value:	0.36	0.0001	0.003	0.05	0.09	0.81	0.69
Summer	estimate:	0.01	0.09	0.29	-0.64	0.97	-1.27	-0.48
	p-value:	0.41	0.001	0.55	0.11	0.05	0.07	0.43
Fall	estimate:	0.02	0.11	0.11	-0.28	1.23	-1.42	-0.96
	p-value:	0.16	<.0001	0.83	0.56	0.02	0.05	0.17
Winter	estimate:	0.02	0.13	0.23	-0.02	0.95	-1.35	-1.19
	p-value:	0.32	<.0001	0.63	0.97	0.07	0.07	0.08
Overall year	estimate:	0.01	0.12	-0.02	-0.44	1.01	-1.11	-0.74
	p-value:	0.35	<.0001	0.96	0.25	0.04	0.06	0.20

F1 - indicator variable for time 1
F2=indicator variable for time 2
Treat*FU₁ = interaction of intervention and time 1
Treat*FU₂=interaction of intervention and time 2
Estimate = estimated regression coefficients

Tab III

Days Missed Work/School

	Age	Baseline BMI	Baseline Persistence	FU ₁	FU ₂	Treat	Treat*FU ₁	Treat*FU ₂
Spring	estimate:	0.05		0.07	-0.30	0.23	-0.62	-0.47
	p-value:	<.0001	3.31	0.87	0.58	0.66	0.36	0.50
Summer	estimate:	0.04		0.91	-0.01	-0.14	-1.02	-0.11
	p-value:	0.01	2.92	0.06	0.99	0.77	0.13	0.87
Fall	estimate:	0.06		1.18	0.13	0.41	-1.32	-0.36
	p-value:	<.0001	3.09	0.01	0.80	0.38	0.05	0.62
Winter	estimate:	0.06		0.06	-0.43	1.09	-1.37	-1.56
	p-value:	<.0001	3.71	0.90	0.36	0.07	0.06	0.03
Overall year	estimate:	0.05		0.58	-0.09	0.38	-1.09	-0.46
	p-value:	<.0001	3.40	0.10	0.84	0.38	0.04	0.46

FU₁ - indicator variable for time 1

FU₂=indicator variable for time 2

Treat*FU₁ = interaction of intervention and time 1

Treat*FU₂=interaction of intervention and time 2

Estimate = estimated regression coefficients

Sexual Activity, Quality of Life, Self-Regulation, Confidence

Table IV

Overall score		Age	Baseline BMI	Baseline Persistence	FU ₁	FU ₂	Treat	Treat*FU ₁	Treat*FU ₂
Bothered by asthma during sexual activities	estimate:	-0.01	0.02	1.33	0.05	0.02	0.40	-0.64	-0.69
	p-value:	0.41	0.08	<.0001	0.79	0.90	0.05	0.01	0.01
Quality of life	estimate:	0.01	0.02	0.64	-0.04	-0.10	0.13	- 0.22	-0.17
	p-value:	<.0001	<.0001	<.0001	0.26	0.04	0.02	< .0001	0.02
Self-regulation	estimate:	0.02	0.01	0.94	-0.01	0.11	0.01	0.21	0.32
	p-value:	<.0001	0.28	<.0001	0.86	0.22	0.39	0.06	0.01
Self-confidence	estimate:	0.02	0.01	-0.01	-0.05	0.06	0.17	0.42	0.35
	p-value:	<.0001	0.33	0.94	0.58	0.56	0.13	0.001	0.01

FU₁ - indicator variable for time 1

FU₂=indicator variable for time 2

Treat*FU₁ = interaction of intervention and time 1

Treat*FU₂=interaction of intervention and time 2

Estimate = estimated regression coefficients

Peak Flow Meter Use

Table V

Frequency of use of peak flow meter in general and use to monitor the most recent attack		Age	Baseline BMI	Baseline Persistence	FU ₁	FU ₂	Treat	Treat*FU ₁	Treat*FU ₂
Frequency	estimate:	0.01	0.01	0.89	-0.32	-0.45	0.40	0.76	0.33
	p-value:	0.03	0.45	<.0001	0.12	0.08	0.07	0.004	0.28
Monitor the last attack	estimate:	0.002	0.01	0.27	0.21	0.17	0.16	0.36	0.44
	p-value:	0.73	0.06	0.04	0.10	0.28	0.35	0.05	0.03

FU₁- indicator variable for time 1

FU₂=indicator variable for time 2

Treat*FU₁= interaction of intervention and time 1

Treat*FU₂=interaction of intervention and time 2

Estimate = estimated regression coefficients

Table VI

Medication Use

		Age	Baseline BMI	Baseline Persistence	FU ₁	FU ₂	Treat	Treat*FU ₁	Treat*FU ₂
Inhaled Corticosteroids	estimate:	0.02	-0.01	0.17	-0.52	-0.58	-0.15	0.02	-0.09
	p-value:	0.001	0.13	0.07	<.0001	<.0001	0.30	0.91	0.62
Oral Corticosteroids	estimate:	0.005	0.03	0.51	-0.05	-0.10	0.34	-0.11	0.41
	p-value:	0.47	0.001	0.001	0.83	0.70	0.17	0.71	0.22
Inhaled Non-steroidal Anti-inflammatory	estimate:	-.0005	-0.07	-0.05	-0.07	-0.01	0.04	0.62	-0.28
	p-value:	0.71	0.01	0.84	0.78	0.97	0.93	0.09	0.58
Anti-Leukotrienes	estimate:	0.01	0.02	0.23	-0.06	-0.02	0.07	0.09	0.05
	p-value:	0.08	0.03	0.01	0.54	0.84	0.62	0.50	0.74
Long-acting inhaled bronchodilators	estimate:	0.02	0.01	0.08	-0.44	-0.70	-0.12	-0.03	-0.21
	p-value:	<.0001	0.48	0.39	<.0001	<.0001	0.44	0.84	0.30
Short-acting inhaled bronchodilators	estimate:	-0.02	0.03	0.48	0.08	0.37	0.32	0.02	-0.59
	p-value:	0.001	0.02	0.004	0.65	0.09	0.18	0.95	0.05

FU₁ - indicator variable for time 1

FU₂=indicator variable for time 2

Treat*FU₁= interaction of intervention and time 1

Treat*FU₂=interaction of intervention and time 2

Estimate = estimated regression coefficients

Table VII

Summary of outcomes with significant improvement in treatment group vs. controls at first and second follow ups

Key outcomes	FU ₁	FU ₂
Night time symptoms	yes	in winter
Day time symptoms	-	in spring
ED visits	yes	-
Unscheduled	yes	-
Scheduled office visits	yes	-
Bothered during sexual activities	yes	yes
Missed work	yes	yes
Quality of life	yes	yes
Self-regulation	yes	yes
Self-confidence	yes	yes
PFM use during attack	-	yes
Bronchodilator use	-	yes