

ASTHMA MANAGEMENT

Effectiveness of a Comprehensive Lifestyle Modification Program for Asthma Patients: A Randomized Controlled Pilot Trial

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Objective. The aim of the study was to investigate the effectiveness and feasibility of conducting a complementary 8-week comprehensive lifestyle modification program (CLMP) compared to standard care in patients with bronchial asthma over a 6-month period. **Methods.** This was a randomized controlled pilot trial with two groups: intervention ($N = 15$) group and attention-placebo control ($N = 14$) group. The intervention group received an 8-week CLMP in addition to standard care. Quality of life, asthma control, lung function, reduction of rescue medication, perceived stress, and psychosocial and spiritual status were measured at the end of the intervention and at the 4-month follow-up. **Results.** In the intervention group, there was a statistically significant difference in the improvements of quality of life, asthma control, lung function, and the reduction of rescue medication intake at both the end of the intervention and at the 4-month follow-up, with no change being observed in the control group. Significant stress reduction and greater psychosocial and spiritual well-being were observed during the 8-week CLMP in the intervention group. At the end of the intervention, the measures of stress and psychological and spiritual well-being reached statistical significance. **Conclusions.** Preliminary findings suggest that adding a CLMP to standard care in patients with bronchial asthma offers greater clinical benefit than standard care alone and also suggest that conducting a large randomized clinical trial is feasible.

Keywords chronic disease self-management program, complementary and integrative medicine, ethicotherapy, psychotherapy, spirituality, yoga

INTRODUCTION

Asthma bronchiale is a chronic inflammatory condition of a multifactorial etiology that is prevalent in most highly developed countries and creates a significant socioeconomic burden on society (1). Despite all the available high-intensity symptomatic treatment, there are many asthma patients with inadequate control (2). Even though asthma bronchiale is a multifactorial disease, current symptomatic treatment does not control for the different factors. It has been shown that psychosocial variables such as patients' emotional state, perceived stress, family relationships, social support, and socioeconomic status play a part in asthma etiopathogenesis as well as asthma self-management, and thus also in asthma control (3–14). Immunoneuroendocrine pathways have been proposed to explain the underlying mind–body mechanisms (15). A number of studies modifying some of these psychosocial factors, such as family therapy, cognitive-behavioral therapy, yoga, relaxation, guided-imagery, hypnosuggestion, and biofeedback, demonstrated improved asthma outcomes and disease self-management (16–23). Implementing a more comprehensive patient-centered treatment regime that takes into account the psychosocial nature of asthma is needed in order to improve patient outcomes further and thereby reduce health care costs. As was demonstrated in patients with cardiovascular disease, lifestyle changes can reverse the course of the

disease (24). Similarly, we propose that lifestyle changes can reverse the course of asthma bronchiale and reduce the occurrence and severity of symptoms.

To date, only one randomized clinical trial has assessed the clinical impact of a comprehensive intervention while considering the multicausal nature of asthma. A 2-week lifestyle modification program based on yoga showed improvement in pulmonary function, and quality of life, and reduction in symptoms, rescue medication, and oxidative stress at the end of the intervention (25,26). However, the long-term effectiveness and the program's impact on patients' psychosocial and spiritual status were not examined and remain unknown.

The purpose of our 6-month pilot comparative study was to investigate the effectiveness and feasibility of conducting a clinical trial designed to evaluate the effectiveness of a complementary Comprehensive Lifestyle Modification Program (CLMP) in patients with asthma bronchiale and compare the results with the effectiveness of standard care. We examined whether changes in lifestyle would not only affect clinical but also psychosocial and spiritual outcomes in patients with asthma bronchiale and whether this effect would last beyond the completion of the program.

METHODS

The design was a pilot, open label, randomized clinical trial (15 September 2009 to 15 March 2010). Twenty-nine patients were randomly assigned to the intervention or the attention-placebo control groups using a computer-

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generated randomization method. The intervention group received an 8-week CLMP in addition to standard care administered at the clinic. The attention-placebo control group received individual conventional asthma education supplemented with a pocket guide for asthma management. All patients including the control group followed a standard symptomatic treatment according to the Global Initiative for Asthma (GINA) guidelines (27).

The study was conducted according to the guidelines of the American Thoracic Society and European Respiratory Society Joint Statement on standardizing endpoints for clinical asthma trials and clinical practice, and was approved by an independent ethics committee (Etická komise Fakultní Nemocnice Hradec Králové) (28). Informed written consent was obtained from all patients.

PATIENTS

All patients fulfilled the following inclusion criteria: (1) Patients had to be of age 18 and older and (2) had to have an established diagnosis of mild-to-severe asthma for at least 6 months partially controlled or uncontrolled by symptomatic treatment based on GINA guidelines (27). Exclusion criteria were occupational asthma, oral or systemic corticosteroid use during the last 6 months, concomitant lung disease or a chronic unstable condition, use of any complementary therapies, use of specific allergen immunotherapy, current or past participation in an integrative self-management program, current nicotine use, and pregnancy. Patients were recruited from an outpatient hospital, a clinic, and community and hospital pharmacies or in response to advertisements in a local newspaper and a regional monthly bulletin.

OUTCOME MEASURES

The primary outcome measures were the quality of life and asthma control scores (Table 1). The measures of secondary subjective and objective health outcomes were visual analogue scale (VAS), lung function, reduction of rescue medication, health care utilization, and patient diaries (Table 1) (29–33). Measures of psychosocial and spiritual status included perceived stress scale (PSS), psychological status, subjective well-being, life satisfaction, general quality of life, and spirituality (Table 1) (34–40). Outcome measures were evaluated at baseline, the end of the 8-week CLMP, and a 4-month follow-up.

Lung Function

Peak expiratory flow rate (PEFR), forced expiratory volume (FEV₁), forced vital capacity (FVC), and FEV₁/FVC ratio were measured at the clinic visits.

Common Cold Episodes

Patients were asked about experiencing a common cold, which was defined as having a sore throat, cough, sneezing, runny and stuffed nose, and/or systemic symptoms at

the visits during the study period and calculated as the average number of episodes per patient per 6 months.

Reduction in Rescue Medication

Patients were asked to record their reliever use in their diaries on every occasion they had to use their bronchodilator for symptom relief 2 weeks prior to the beginning of the study as well as throughout the study period. Reliever use was expressed as the mean number of occasions per day averaged over 1 week.

Health Care Utilization

Health care services included scheduled and unscheduled primary care consultations, emergency visits, and intensive care unit and hospital admissions. The mean number of visits per patient per 6 months was calculated. Severe asthma exacerbations were also recorded and calculated on a per patient per 6 months base as the number of courses of systemic corticosteroid use or an increase from a stable physician-prescribed standardized maintenance dose for at least 3 days.

TREATMENT INTERVENTION

The 8-week self-management program involved four group meetings on lifestyle changes based on yoga (1.5 hours per session) and four individual sessions on psychotherapy based on Eastern philosophy and ethicotherapy (1 hour per session).

Lifestyle changes included an asthma-specific diet (Mediterranean style and allergen-free diet), yogic postures (asanas), stress management training encompassing relaxation (shavasana), breathing techniques (pranayamas), meditation, emotion management, and effective communication skills training (41). Patients were told to practice lifestyle changes every day. Each patient received a workbook and a diary for keeping notes on the program assignments and practices. The biopsychosocial and spiritual model of asthma was also explained to the patients during the first session. All group sessions were educational and were followed by a discussion and skill training. Barriers to lifestyle changes required by the program were discussed at the beginning of each session. All yoga and psychotherapy sessions were conducted by a certified yoga instructor and a psychotherapist specialized in spirituality-based cognitive-behavioral therapy (42).

CLMP ADHERENCE

Patients recorded their program activities every day in their diaries.

Adherent patients were defined as those patients who practiced an asthma-specific diet, yogic postures, relaxation, breathing techniques, meditation, communication, and emotion management strategies at least four times a week and completed all psychotherapy sessions.

TABLE 1.—A summary of instruments used in the study.

Instrument	Outcome measure	Items (no.)	Scale	Score
Asthma Quality of Life Questionnaire (AQLQ), Juniper et al. (29,30)	Asthma quality of life	32	1–7 point	A higher score indicated better quality of life with MID ^a ≥ 0.5 being considered clinically significant.
	Symptoms Activities Emotions Environment			
The Asthma Control Questionnaire (ACQ) ^b , short version Juniper et al. (31,32)	Asthma control	6	0–6 point	A well-controlled asthma = a mean score of ≤ 0.75 . Uncontrolled asthma = a mean score of ≥ 1.5 .
Asthma Control Test (ACT), Nathan et al. (33)	Asthma control	5	1–5 point	Well-controlled = a total score of ≥ 20 . Poorly controlled asthma = a total score of ≤ 15 .
Visual analogue scale (VAS)	General burden of asthma symptoms	–	0–100 mm	A lower score indicated lower burden of asthma symptoms.
Perceived Stress Scale (PSS), Cohen et al. (34).	Degree to which situations in one's life are appraised as stressful	10	0–4 point	A lower score indicated lower stress level.
Symptom Checklist-90 (SCL-90), Derogatis et al. (35).	The psychopathology profile in nine psychologic dimensions ^c	90	0–4 point	A lower score indicated psychopathology symptoms.
Subjective Quality of Life Analysis (SQUALA), Zannotti et al. (36)	General quality of life based on Maslow's theory of needs	23	1–4 point	A lower score indicated better quality of life. ^d
Rosenberg's self-esteem scale (RSES), Rosenberg et al. (37)	Self-esteem	10	1–6 point	A lower score indicated a higher self-esteem.
Positive attitudes toward life subscale of the Berner Questionnaire for Well-Being (BFW), Berner et al. (38)	Positive attitudes toward life	9	1–6 point	A lower score indicated more positive attitudes.
Spirituality ^e Personal Meaning Profile (PMP), Wong (39)	Peoples' perceived sense of meaning in their lives	57	1–6 point	A lower score indicated higher spirituality.
Ecospirituality subscale of the Prague Spiritual Questionnaire (PSQ), Rican et al. (40)	Peoples' connectedness with nature	10	1–6 point	A lower score indicated higher spirituality.

Notes: ^aMinimal important difference.

^bThe ACQ score of a short version of the ACQ (6-items) was calculated as the mean score of all questions and ranged from 0 (totally controlled asthma) to 6 (severely uncontrolled asthma).

^cNine dimensions: somatization, obsessive-compulsive signs, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism.

^dRespondents rate how important each of the 23 life areas is to their life and then indicate their current degree of satisfaction with them.

^eSpirituality was defined as a capacity of transcending physical limitations through meaning and spirituality and was measured by combining the Personal Meaning Profile and Ecospirituality subscale of the Prague Spiritual Questionnaire.

RESOURCE USE

Data such as medication and health care service use (specialist visits, emergency visits, and hospitalizations), demographics, and comorbidity conditions were collected using a patient questionnaire and were cross-checked by data retrieval from the outpatient database of patient medication records.

STATISTICS

Categorical data between the groups were analyzed using the chi-square test or Fisher's exact test. Wilcoxon signed-rank test, Mann–Whitney test, and *t*-tests were used for numerical variables. *P*-values $< .05$ were considered significant. The analyses were performed using the statistical package SPSS[®] version 15.0 (SPSS Inc., Chicago, IL, USA), SISA—Fisher

2×5 (Daan G. Uitenbroek, <http://www.quantitativeskills.com/sisa/statistics/fiveby2.htm>), and G*Power version 3.1.3 (Erdfelder, Faul & Buchner) (43).

RESULTS

Patients

A total number of 29 patients were either assigned to receive intervention treatment in addition to standard care ($N = 15$) or were assigned to an attention-placebo control group ($N = 14$). Two patients from the control group were withdrawn from the study within the first 2 weeks due to inconvenience (change of residence). There were no statistically significant differences between the groups in the baseline characteristics. The patient characteristics are shown in Table 2.

TABLE 2.—Characteristics of patients.

	Intervention group, <i>N</i> = 15		Control group, <i>N</i> = 12	
Age (years)				
Mean (SD)	50.7	(15)	54.7	(14.2)
Median	56		58	
Female, <i>n</i> (%)	14	(93)	11	(92)
Body mass index, mean (SD)	26	(4)	29	(5)
Asthma severity, <i>n</i> (%)				
Mild	2	(13)	4	(33)
Moderate	8	(53)	4	(33)
Severe	5	(33)	4	(33)
History of allergic rhinitis, <i>n</i> (%)	8	(53)	5	(42)
Positive family history of asthma, <i>n</i> (%)	8	(53)	9	(75)
Duration of asthma (years)				
Mean (SD)	11.1	(9.8)	10.3	(5.2)
Median (min, max)	9	(1, 33)	10	(1, 19)
Visual analogue score (mm), median	5		4	
Asthma quality of life (AQLQ), mean (SD)				
Symptoms	4.6	(1.6)	5.1	(1.2)
Activities	4.8	(1.6)	4.8	(1.3)
Emotions	4.7	(1.4)	5.6	(1.1)
Environment	5.1	(1.3)	5.3	(1.1)
Total score	4.7	(1.5)	5.1	(1.1)
Asthma control, mean (SD)				
ACQ	1.8	(1.5)	1.4	(1.2)
ACT	16.9	(5.1)	19.2	(4.0)
Drug consumption				
Rescue medication use, ^a mean (SD)	4.7	(5.2)	3.8	(5.1)
Inhaled steroid dose (mcg/day), mean (SD) ^b	1139	(678)	1335	(726)
Smokers, <i>n</i> (%)				
Smokers	0	(0)	0	(0)
Ex-smokers	1	(7)	3	(25)
Never smoked	14	(93)	9	(75)
Education, <i>n</i> (%)				
Less than high school	0	(0)	0	(0)
High school	12	(80)	9	(75)
University	3	(20)	3	(25)
Residency, <i>n</i> (%)				
Rural	3	(20)	3	(25)
Urban	12	(80)	9	(75)
Satisfaction with standard of living, <i>n</i> (%)				
Satisfied	14	(93)	12	(100)
Highly satisfied	1	(7)	0	(0)
Dissatisfied	0	(0)	0	(0)
Marital status, <i>n</i> (%)				
Living together	10	(67)	10	(83)
Single/separated/divorced/widow	5	(33)	2	(17)
Religious identity, <i>n</i> (%)	6	(40)	5	(42)

Notes: ACT, Asthma Control Test; ACQ (short version), Asthma Control Questionnaire; AQLQ, Asthma Quality of Life Questionnaire.

^aReliever use is expressed as a mean number of occasions per day averaged over 1 week.

^bWe considered corticosteroid intake over the past 1–2 weeks as a dose equivalent to beclomethasone dipropionate (by multiplying budesonide, mometasone, and triamcinolone doses by 1.5 and fluticasone propionate and flunisolide by 2).

EFFECTIVENESS

Quality of Life

At the end of the intervention, the number of patients who achieved a clinically important improvement in quality of life (the mean changes exceeded the threshold for minimal important difference) as measured by the Asthma Quality of

Life Questionnaire (AQLQ) significantly differed between the two groups (intervention group vs control group: 6 (40%) vs 0 (0%) improved, 8 (53%) vs 10 (83%) unchanged, 1 (7%) vs 2 (17%) deteriorated; extended Fisher's exact test, $p = .028$) (Table 3). At the end of the study, the difference still remained significant (extended Fisher's exact test, $p = .014$) (the number of clinically improved patients in the intervention group still increased moderately: 7 (47%) improved, 7 (47%) unchanged, 1 (7%) deteriorated, whereas the control group remained without further changes). The AQLQ scores showed an increase in the overall quality of life, symptoms, and activity domains at the end of the CLMP and the 4-month follow-up within the intervention group with a deterioration observed within the control group (Table 3).

Asthma Control

Significant positive changes in the Asthma Control Questionnaire (ACQ) and Asthma Control Test (ACT) scores were only seen within the intervention group both at the end of the CLMP (Wilcoxon signed-rank test one-tailed, ACQ: $p = .005$, ACT: $p < .001$) and the 4-month follow-up (Wilcoxon signed-rank test one-tailed, both ACQ and ACT: $p = .003$). When comparing the score developments of the two groups against each other, in the ACQ there was a significantly greater change within the intervention group than within the control group (Mann-Whitney test, $p = .015$) both at the end of the CLMP and after the 4-month follow-up (Mann-Whitney test, $p = .002$ and $p = .024$ respectively), whereas changes in the ACT score were significantly different only at the end of the CLMP (Mann-Whitney test, $p = .015$) (Table 3).

According to the ACT results, the number of patients reaching full asthma control in the intervention group was substantially higher after the CLMP in comparison to the baseline (9 (60%) vs 5 (33%)), and this remained so until the end of the study. By contrast, in the control group there was no change throughout the study. Also, according to the ACQ results, the number of patients reaching full asthma control in the intervention group substantially increased in the first 2 months of the study in comparison to the baseline (7 (47%) vs 3 (20%)), whereas there was no increase in the control group. However, after the 4-month follow-up, the changes in both the groups were approximately at the same level (improvement by one in comparison to the baseline in each group).

Lung Function

There were significant changes in FVC (paired t -test, $p = .003$), FEV₁ (paired t -test, $p = .035$) and PEFR (paired t -test, $p = .015$) as measured by spirometry within the intervention group after the intervention with only PEFR still statistically significant at the 4-month follow-up (paired t -test, $p = .04$). The intervention group significantly differed in the FVC (unpaired t -test, $p = .001$), FEV₁ (Mann-Whitney test, $p = .005$), PEFR (unpaired t -test, $p = .003$), and PEF_{25%–75%} (Mann-Whitney test, $p = .017$) results from the control group at the end of the CLMP. Only PEFR (unpaired t -test,

TABLE 3.—Change in clinical outcome from the baseline to the end of the 8-week program and the 4-month follow-up^a.

	Intervention group, <i>N</i> = 15	Control group, <i>N</i> = 12	DI (Δ)	CI 95%
Asthma quality of life (AQLQ)				
Second month				
Symptoms	0.56** (0.71)	−0.06 (0.34)	0.62****	[0.19–1.05]
Activities	0.47* (0.71)	−0.20 (0.69)	0.68***	[0.12–1.24]
Emotions	0.35 (0.83)	−0.15 (0.35)	0.5	[−0.03–1.03]
Environment	0.30 (1.07)	−0.06 (0.30)	0.36	[−0.25–0.98]
Total score	0.47* (0.64)	−0.13 (0.29)	0.59****	[0.20–0.98]
Sixth month				
Symptoms	0.49* (0.79)	−0.08 (0.34)	0.58***	[0.07–1.08]
Activities	0.56* (0.96)	−0.11 (0.79)	0.68	[−0.03–1.38]
Emotions	0.4 (0.88)	−0.27 (0.5)	0.67***	[0.08–1.26]
Environment	0.17 (1.21)	−0.19 (0.66)	0.35	[−0.45–1.16]
Total score	0.46* (0.84)	−0.14 (0.37)	0.60***	[0.09–1.10]
Visual analogue score				
Second month	−13* (18)	3 (7.8)	−17****	[−28 to −6]
Sixth month	−17* (23)	2 (13.9)	−18***	[−33 to −4]
Asthma control				
ACQ				
Second month	−0.49** (0.53)	0.07 (0.50)	−0.56***	[−0.97 to −0.14]
Sixth month	−0.53* (0.46)	−0.18 (0.64)	−0.35	[−0.79–0.08]
ACT				
Second month	2.26** (2.01)	−0.33 (3.60)	2.6***	[0.35–4.85]
Sixth month	2.33** (2.89)	0.08 (3.72)	2.25	[−0.37–4.87]
Rescue medication reduction				
Second month	−0.49* (0.69)	0.05 (0.59)	−0.53***	[−1.05 to −0.02]
Sixth month	−0.57* (0.71)	−0.12 (0.83)	−0.45	[−1.06–0.16]

Notes: ACT, Asthma Control Test; ACQ (short version), Asthma Control Questionnaire; AQLQ, Asthma Quality of Life Questionnaire.

^aData are presented as mean (SD).

*Level of significance .05 (within group comparison, Wilcoxon signed-rank test).

**Level of significance .01 (within group comparison, Wilcoxon signed-rank test).

***Level of significance .05 (between-group comparison, Mann–Whitney test).

****Level of significance .01 (between-group comparison, Mann–Whitney test).

$p = .04$) and $PEF_{25\%-75\%}$ (Mann–Whitney test, $p = .032$) remained statistically significantly different between the groups at the 4-month follow-up (Table 5).

Reduction in Rescue Medication

At each visit, there was a noticeable drop in the need for rescue medication within the intervention group (paired t -test, $p = .017$), whereas no decrease was observed within the control group. A significant decrease in symptomatic medication consumption was also reached within the intervention group at the 4-month follow-up (paired t -test, $p = .008$). Between-group difference was statistically significant (rescue medication reduction (mean) – intervention group vs control group: -0.49 vs $+0.05$; unpaired t -test, $p = .04$) (Table 3).

Health Care Utilization

On average, the control group patients visited their allergologist 2.8 times more frequently than patients in the intervention group during the follow-up period. No severe exacerbations, hospitalizations, or emergency visits related to bronchial asthma were reported during the study. No lifestyle intervention-related problem was reported during the study. Drug-related problems such as palpitations, oral candidosis, and throat hoarseness were reported at baseline in both the groups with no side effects occurring in the intervention group at the 4-month follow-up.

Common Cold Episodes

The intervention and the control groups did not differ significantly in the occurrence of common cold episodes either 6 months prior to study initiation (intervention group vs control group—mean: 0.93 vs 0.42, median: 1 vs 0) or at the 4-month follow-up (intervention group vs control group—mean: 0.27 vs 0.50, median: 0 vs 0). Nevertheless, significant improvement in the occurrence of common cold episodes was confirmed only in the intervention group (Wilcoxon signed-rank test, $p = .016$).

Psychosocial and Spiritual Status

The changes in the mean PSS scores were -3.07 within the intervention group and -0.25 within the control group at the end of the CLMP, reflecting the intervention group patients' significantly lower levels of perceived stress compared to the control group at the end of the CLMP (Mann–Whitney test, $p = .029$). Although between-group differences were not statistically significant at the end of the 4-month follow-up (Mann–Whitney test, $p = .103$), the PSS score remained lower in the intervention group throughout the study. On the other hand, patients in the control group experienced an increase in the PSS score at the end of the 4-month follow-up (Table 4).

A significant improvement in the overall mean SCL-90 score (Wilcoxon signed-rank test, $p = .04$)

TABLE 4.—Change in psychosocial and spiritual well-being from the baseline to the end of the 8-week program and the 4-month follow-up^a.

	Intervention group, <i>N</i> = 15		Control group, <i>N</i> = 12		DI (Δ)	CI 95%
Perceived stress (PSS)						
Second month	-3.07*	(4.92)	-0.25	(2.9)	-2.82**	[-6.13-0.49]
Sixth month	-2.27	(6.47)	0.75	(3.38)	-3.02	[-7.27-1.24]
Psychological status (SCL)						
Second month						
Anxiety	-0.11	(0.34)	-0.04	(0.12)	-0.07	[-0.26-0.13]
Depression	-0.13	(0.29)	0.00	(0.13)	-0.13	[-0.30-0.05]
Somatization	-0.23*	(0.29)	0.02	(0.19)	-0.25**	[-0.45 to -0.06]
Interpersonal sensitivity	-0.08	(0.32)	0.00	(0.20)	-0.08	[-0.29-0.13]
Hostility	-0.07	(0.23)	0.03	(0.06)	-0.09	[-0.23-0.04]
Phobic anxiety	-0.07	(0.17)	-0.01	(0.07)	-0.05	[-0.16-0.05]
Total score	-0.12*	(0.21)	0.00	(0.05)	-0.12**	[-0.25 to -0.002]
Sixth month						
Anxiety	-0.08	(0.31)	-0.06	(0.10)	-0.02	[-0.20-0.15]
Depression	-0.06	(0.32)	-0.03	(0.11)	-0.03	[-0.22-0.16]
Somatization	-0.06	(0.25)	0.05	(0.21)	-0.11	[-0.30-0.08]
Interpersonal sensitivity	-0.02	(0.25)	0.00	(0.16)	-0.02	[-0.19-0.15]
Hostility	-0.12*	(0.23)	0.01	(0.09)	-0.14**	[-0.28 to -0.001]
Phobic anxiety	-0.06	(0.17)	-0.04	(0.09)	-0.02	[-0.13-0.09]
Total score	-0.07	(0.21)	0.00	(0.05)	-0.06	[-0.18-0.05]
Second month						
Subjective quality of life (SQUALA)	0.04	(0.37)	0.10	(0.29)	-0.07	[-0.34-0.20]
Self-esteem (RSES)	0.00	(0.49)	0.10	(0.37)	-0.10	[-0.45-0.25]
Positive attitudes toward life (BFW)	0.07	(0.28)	0.10	(0.22)	-0.03	[-0.23-0.17]
Spirituality (PMP, PSQ)	-0.12	(0.24)	0.02	(0.13)	-0.15**	[-0.30 to -0.002]
Sixth month						
Subjective quality of life (SQUALA)	0.00	(0.43)	0.21	(0.41)	-0.22	[-0.56-0.12]
Self-esteem (RSES)	-0.05	(0.57)	0.23	(0.47)	-0.28	[-0.70-0.14]
Positive attitudes toward life (BFW)	0.05	(0.31)	0.20	(0.39)	-0.15	[-0.43-0.12]
Spirituality (PMP, PSQ)	-0.11	(0.26)	0.02	(0.15)	-0.13	[-0.29-0.04]

Notes: BFW, Positive attitudes toward life subscale of the Berner Questionnaire for Well-Being; PMP, Personal Meaning Profile; PSQ, Ecospirituality subscale of the Prague Spirituality Questionnaire; PSS, Perceived Stress Scale; RSES, Rosenberg's self-esteem scale; SCL, Symptom Check-list 90; SQUALA, Subjective Quality of Life Analysis Questionnaire.

^aData are presented as mean (SD).

*Level of significance .05 (within group comparison, Wilcoxon Signed-Rank Test).

**Level of significance .05 (between group comparison, Mann-Whitney test).

TABLE 5.—Change in pulmonary function from the baseline to the end of the 8-week program and the 4-month follow-up^a.

	Intervention group			Control group			DI (Δ)	CI 95%
	<i>N</i> ^b			<i>N</i> ^b				
Lung function								
Second month								
FVC (% of predicted)	13	10.99*	(10.78)	9	−4.68	(8.06)	15.67***	[6.82–24.52]
FEV ₁ (% of predicted)	14	7.14*	(11.32)	9	−3.52	(3.94)	10.66**	[3.71–17.6]
FEV ₁ FVC (% of predicted)	12	−0.15	(9.84)	7	−0.12	(3.62)	−0.04	[−6.75–6.68]
PEFR (% of predicted)	13	7.90*	(10.10)	9	−7.60	(10.85)	15.50***	[6.09–24.91]
PEF 25–75 (% of predicted)	12	7.81	(13.22)	7	−3.31	(3.85)	11.12**	[2.36–19.89]
Sixth month								
FVC (% of predicted)	13	2.28	(9.27)	9	−2.83	(7.82)	5.12	[−2.90–13.13]
FEV ₁ (% of predicted)	14	4.37	(8.83)	9	−1.31	(4.98)	5.68	[−1.13–12.49]
FEV ₁ FVC (% of predicted)	12	4.51	(7.57)	7	−0.29	(4.27)	4.80	[−1.89–11.49]
PEFR (% of predicted)	13	5.15*	(7.90)	9	−5.62	(14.99)	10.77**	[0.22–21.32]
PEF 25–75 (% of predicted)	12	7.68	(11.64)	7	−2.51	(6.69)	10.20**	[1.02–19.37]

^aData are presented as mean (SD).

^bNumber of patients whose data on pulmonary function test results was available.

*Level of significance .05 (within group comparison, paired *t*-test, Wilcoxon Signed-Rank Test).

**Level of significance .05 (between group comparison, unpaired *t*-test, Mann-Whitney test).

***Level of significance .01 (between group comparison, unpaired *t*-test, Mann-Whitney test).

and in the somatization dimension score (Wilcoxon signed-rank test, $p = .008$) was noted only within the intervention group at the end of the CLMP, indicating an improvement in their psychological status.

The mean hostility score also reached a significant reduction at a 4-month follow-up in the intervention group only (Wilcoxon signed-rank test, $p = .034$) (Table 4).

The changes in spirituality became statistically significant between groups at the end of the CLMP (Mann–Whitney test, $p = .04$) with no significant change being observed at the 4-month follow-up (Table 4).

CLMP Adherence

All subjects completed the CLMP. Sixty-seven percent of the patients adhered to the program, practicing a minimum of 4 days a week. Program adherence rate decreased from 67% to 20% at the 4-month follow-up. Adherent patients experienced better asthma outcomes and asthma control than non-adherent patients at the end of the 8-week CLMP and the 4-month follow-up (VAS (mean), 8 week: 2.0 vs 6.3; Mann–Whitney test, $p = .007$; follow-up: 1.4 vs 6.6; Mann–Whitney test $p = .011$. AQLQ (mean), 8 week: 5.8 vs 3.98; Mann–Whitney test, $p = .035$; follow-up: 5.8 vs 3.86; Mann–Whitney test, $p = .018$. ACQ (mean), 8 week: 0.96 vs 2.83; Mann–Whitney test, $p = .016$; follow-up: 0.99 vs 2.63; Mann–Whitney test, $p = .044$. ACT (mean), 8 week: 4.3 vs 2.96; Mann–Whitney test, $p = .020$; follow-up: 4.3 vs 2.8; Mann–Whitney test, $p = .005$).

Sample Size Calculation

We plan to follow this pilot study with a larger clinical trial. On the basis of the results obtained in this pilot study, we calculated that in order to reach a power of 0.8 for the between-group comparisons in AQLQ and asthma control, the size of the sample for the planned larger clinical trial should be at least 104.

DISCUSSION

This study was a 6-month pilot open-label, randomized clinical trial that assessed the clinical and psychosocial and spiritual benefits of an 8-week CLMP in patients with mild-to-severe asthma bronchiale. A reduction in symptoms, symptomatic drug intake, and improvements in pulmonary function, asthma control, quality of life, perceived stress, psychological status, and spirituality were observed in the intervention group at the end of the CLMP compared to the baseline.

To our knowledge, no prior study has investigated the effectiveness of a CLMP that considers the multicausal nature of asthma in patients with asthma bronchiale. There is only one randomized controlled clinical trial performed by Vempati et al. that partially resembles our study. Vempati et al. applied a 2-week lifestyle modification and stress management program based on yoga (diet, yogic postures, counseling, cleansing, relaxation, and breathing techniques) in addition to standard care in patients with asthma bronchiale (25). The patients in their study were instructed to continue their yoga practice at home and were monitored for a total period of 6 weeks. Our results were consistent with the study's published findings and also showed a significant difference in the improvements of quality of life, a reduction of rescue medication intake, and an improved lung function (FEV_1 and PEF). Compared to our study,

Vempati's observed greater changes in the quality of life scores, and the differences in all pulmonary function markers were statistically significant between the groups at follow-up. This may be explained by a number of differences between the two studies. Compared to our study, Vempati and team enrolled a smaller percentage of subjects with more severe type of asthma (severe asthma: 0% vs 33%, moderate asthma: 58% vs 44%, mild asthma: 42% vs 22% in our study). Furthermore, Vempati's intervention program had a higher training intensity (4 hours/day over 2 weeks vs 1–1.5 hours/week over 2 months in our study), it included telephone support (vs no telephone support in our study), and their follow-up period was significantly shorter (6 weeks vs 4 months in our study). These study design differences may have contributed to the greater improvements in asthma outcomes in Vempati's study.

Because of the biopsychosocial nature of asthma, we measured not only clinical but also psychosocial and spiritual outcomes. Patients in the intervention group experienced a lower level of perceived stress and improved their overall psychological well-being. As research shows, an increased level of perceived stress as well as anxiety can induce hypercapnia, hyperventilation, and bronchoconstriction and worsen asthma symptoms (44). The mechanism of action of such mind–body connections can be explained by an interaction of the immune, hormonal, and nervous systems. Some studies have shown that the immune as well as the autonomous nervous system functions can be balanced by practicing relaxation, meditation, and breathing techniques that release patients' stress and anxiety, and that they have a positive impact on alleviating asthma symptoms (15,45). It was also shown that relaxation techniques based on muscle relaxation produced promising results in improving lung function (44). Furthermore, high levels of anxiety and depression were directly linked to worse asthma control, worse self-management, and an increase in health care utilization. In particular, the study of Braido et al. found an association between mood, uncontrolled asthma, and suboptimal level of quality of life (13,44,46,47).

Due to the immunosuppressive effect of chronic stress and depression, there is also an increased risk of viral and atypical bacterial upper respiratory tract infections exacerbating asthma symptoms (15,48). In our study, the intervention group receiving CMLP experienced 3.5 times fewer occurrences of common cold episodes as well as lower levels of perceived stress.

The focus on spirituality and conflict resolution during psychotherapy sessions in our study may have contributed to a decreased level of stress and the improvement of asthma symptoms. As shown previously, a stronger sense of meaning in life can in turn decrease the levels of stress and depression and improve immune system function as well as general life well-being (49). In addition, the social support that the patients received as part of the program may also have contributed to the overall program effectiveness since

studies show that social support can not only reduce the levels of stress, anxiety, and depression but also improve asthma self-management and adherence rates (15).

Most published studies that investigate yoga effectiveness in asthma reduce yoga to a particular technique such as breathing, omitting the complex nature of yoga. This may be one of the reasons why results of a recent systematic review of benefits of yoga in asthma remained inconclusive (50). A CLMP may, therefore, yield more conclusive evidence for the benefits of yoga in asthma through a cumulative effect of its individual components.

The results demonstrated the feasibility of conducting a larger clinical trial as well as integrating the program into routine care due to the benefits and the low intervention cost (educator time and training, educational materials), which was estimated at \$133 per participant (using 20.54Kč/1\$ exchange rate of 30/07/2012). The strengths of the study were the inclusion of a greater range of psychosocial and spiritual measures than in the previous studies, the use of an attention-placebo group, and a zero program drop-out rate in the intervention group.

There were a couple of study limitations, however. Psychosocial status data relied on subjective self-reported data and were not verified by objective measures or observers to ensure validity of self-reports. The study targeted patients who agreed to participate in the program and may thus not be generalizable to all asthma patients. We expect the program to be well-applicable across other patient groups with allergy and other chronic conditions, since it has been demonstrated that lifestyle modification can play a significant role in chronic disease management (24). Even though we used attention-placebo group to ensure that patients in the control group receive the same amount of time and attention, we did not control for nonspecific variables of all the different components of the intervention such as yogic posture or meditation practice. Also, the observed adherence rates suggest that the use of additional adherence-enhancing techniques such as greater social support (e.g., a follow-up letter or a phone call) would be desirable to further improve the clinical outcomes in patients in the intervention group, especially during the follow-up period. We aim to introduce online support to enhance program adherence.

CONCLUSIONS

It is feasible to conduct a large randomized clinical trial as planned. Our preliminary findings suggest that from both societal as well as patient well-being perspectives, the CLMP for asthma improves subjective as well as objective clinical asthma outcomes and offers a real clinical benefit to the current standards of asthma care. However, larger clinical trials are needed to establish the program's cost-effectiveness, its effect in patients with newly diagnosed asthma, and its preventive effect on the development of asthma in children with positive family history.

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DECLARATION OF INTEREST

We declare that we have no conflict of interest. There was no financial conflict of interest at any stage of the research work, design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the article.

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