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QUALITY OF LIFE

Improvement in Asthma Quality of Life in Patients Enrolled in a Prospective Study to Increase Lifestyle Physical Activity

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Objective. Asthma patients know the benefits of exercise but often avoid physical activity because they are concerned that it will exacerbate asthma. The objective of this analysis was to assess longitudinal asthma status in 256 primary care patients in New York City enrolled in a trial to increase lifestyle physical activity. *Methods.* Patients were randomized to two protocols to increase physical activity during a period of 12 months. At enrollment, patients completed the Asthma Quality of Life Questionnaire (AQLQ) and the Asthma Control Questionnaire (ACQ) and received asthma self-management instruction through an evaluative test and workbook. Exercise and self-management were reinforced every 2 months. The AQLQ was repeated every 4 months and the ACQ was repeated at 12 months. *Results.* The mean age was 43 years and 75% were women. At 12 months there were clinically important increases in physical activity with no differences between groups; thus, data were pooled for asthma analyses. The enrollment AQLQ score was 5.0 ± 1.3 and increased to 5.9 ± 1.1 corresponding to a clinically important difference. Correlations between AQLQ and physical activity were approximately 0.35 ($p < .0001$) at each time point. In a mixed effects model, the variables associated with improvement in AQLQ scores over time were male sex, less severe asthma, not taking asthma maintenance medications, fewer depressive symptoms, and increased physical activity (all variables, $p < .03$). According to the ACQ, asthma was well controlled in 38% at enrollment and in 60% at 12 months ($p < .0001$). *Conclusion.* With attention to self-management, increased physical activity did not compromise asthma control and was associated with improved asthma.

Keywords asthma control, asthma self-management, energy expenditure, exercise, kcal/week

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INTRODUCTION

Benefits of physical activity are well-established and include improving cardiovascular and mental health and maintaining desired weight. However, many patients with asthma avoid physical activity because they are concerned that it will exacerbate their asthma (1, 2). This concern is understandable as exercise-induced bronchospasm is a clinically measurable phenomenon, which can occur to some degree in almost all patients and may require treatment with bronchodilators (3, 4).

Patients' concerns about exercise derive from personal and social network experiences and apply to formal exercise as well as to moderate-intensity daily activities (1, 5). Because asthma affects young individuals, avoiding routine healthy activities such as climbing stairs often becomes a habit early in life and persists throughout adulthood (1). However, despite self-reported levels of lower physical activity compared to age-matched peers, asthma patients acknowledge that there are multiple benefits of physical activity and many believe that they can increase physical activity if they take their asthma medications, pace themselves, and choose a prudent activity, such as walking more (1, 6, 7).

The clinical challenge, therefore, is to help asthma patients be physically active, while at the same time ensure that asthma remains controlled (3, 4). The objective of this analysis was to assess longitudinal asthma status measured by the *Asthma Quality of Life Questionnaire* (AQLQ) and the *Asthma Control Questionnaire* (ACQ) in patients enrolled in a trial to increase lifestyle physical activity.

METHODS

Description of the Physical Activity Trial

The randomized controlled trial consisted of two multicomponent educational and motivational protocols to increase physical activity during 12 months. The trial was approved by the Institutional Review Board of Weill Cornell Medical College/New York–Presbyterian Hospital and all patients provided written informed consent. The trial has been described in detail elsewhere (8, 9). In brief, patients followed at the Weill Cornell Internal Medicine Associates primary care practice in New York City were eligible if they had mild-to-moderate persistent asthma, were English speaking, had access to a telephone, had no limitations in mobility, and had no other respiratory or major comorbidity. At enrollment, all patients were

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instructed on the benefits of physical activity, were given a pedometer, and made a contract to be more physically active, which for most patients was to walk more. Patients in one group also received instruction in linking positive affect and self-affirmation to physical activity. Specifically, patients were encouraged to think positive thoughts and to recall self-affirming achievements that could serve as patient-specific motivators to help fulfill physical activity goals. There was no observation-only control group in this trial because usual care is well-known to be ineffective for changing physical activity and exercise behavior. Energy expenditure was measured with the self-report *Paffenbarger Physical Activity and Exercise Index*, which considers three domains, walking, stair-climbing, and sports/exercise, and is reported in kilocalories/week (kcal/week) (10). An increase of 336 kcal/week is associated with a reduction in cardiovascular risk and is considered a clinically important increase in physical activity or energy expenditure (11). Details about the types of activities and exercises for patients in our study were reported previously, and included mostly weight lifting and aerobic activities (12). Every 2 months until 12 months, patients were contacted by telephone to reinforce the protocols and to obtain current kcal/week. At the end of the trial, clinically important increases in physical activity occurred in both groups with no differences between groups (9). Thus, the present analysis pools the entire sample to assess the change in asthma status during the trial.

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Description of Asthma Assessments

To minimize any potential adverse effects of increased physical activity on asthma, at enrollment the patients were instructed on asthma self-management. First, they were given the *Asthma Self-Management Questionnaire* (ASMQ), a validated instructional test comprising 16 questions addressing medications, recognition and avoidance of triggers, and techniques to manage exacerbations (13). Each question has a multiple-choice response format, and an overall score is calculated which can range from 0 to 100, with higher scores indicating greater knowledge of self-management. At enrollment in this trial, each patient's responses, as well as correct responses, were reviewed individually with each patient. All patients were also given *Take Control of Your Asthma: an Individualized Workbook for Self-Management*, an 18-chapter interactive illustrated workbook addressing asthma knowledge and self-efficacy (14). One chapter specifically focuses on the management of asthma during exercise. The study personnel reviewed the workbook with the patients at enrollment, and at each 2-month follow-up the patients were encouraged to continue reading the workbook and selected chapters were recommended.

Several validated scales were used to measure asthma status at enrollment. The ACQ is a 7-item scale measuring the short-term status and focuses on recent symptoms, medications, and forced expiratory volume in 1 second (FEV_1), which was obtained with a portable spirometer (15). Scores for the ACQ range from 0 to 6, with lower scores indicating better asthma control. A score ≤ 0.75 indicates well-controlled asthma and ≥ 1.5 not well-controlled asthma. The *Severity of Asthma Scale* (SOA) is a 13-item scale reflecting the long-term asthma status based on prior medications and hospitalizations for asthma (16). Scores for the SOA range from 0 to 28, with higher scores reflecting more severe asthma. The AQLQ is a 32-item scale measuring the symptoms, activity limitations, and emotional and environmental effects of asthma (17). Scores range from 1 to 7, with higher scores indicating better status. Increases in scores of 0.5, 1.0, and 1.5 correspond to minimal, moderate, and marked clinically important improvements, respectively (18). The AQLQ was also measured at the 4-, 8- , and 12-month telephone follow-ups, for a total of three possible repeat measurements. Patients who were not able to complete the AQLQ at 4 or 8 months were offered the opportunity to do so at 6 or 10 months, respectively, when they were contacted by telephone for measurements of physical activity. Patients also completed the ACQ at the final 12-month follow-up.

Demographic and clinical data were obtained from patients and chart review. Information about medication usage was obtained from patients at enrollment and close-out and was compared with the prescribed medications listed in the chart. Psychosocial measures included the *Geriatric Depression Scale*, a 30-item scale valid in younger adults assessing psychological depressive symptoms on a scale of 0–30, with higher scores reflecting more depressive symptoms and a score of ≥ 11 indicating a positive screen for depression (19).

Data Analysis

The main analysis was the repeated measurement of asthma status every 4 months assessed with a mixed effects model with AQLQ score from enrollment and each follow-up as the dependent variable, and the pattern of Paffenbarger Index physical activity values as the main independent variable. Each patient constituted a random factor, and time from enrollment was a fixed-time variable. Additional variables included in the model were age, sex, and asthma severity, as well as enrollment measurements of depressive symptoms, smoking status, and use of maintenance asthma medications. These variables were chosen based on their clinical relevance to the AQLQ, as demonstrated in other trials. Additional analyses included assessing correlations between AQLQ scores and Paffenbarger Index values at enrollment, 4, 8, and 12 months. Differences between enrollment and 12-month ACQ scores were compared with paired tests, and the association between change in ACQ scores and Paffenbarger Index values was assessed in a multivariate linear regression model controlling for the covariates cited above. Analyses were carried out in SAS (20).

RESULTS

In total, 450 patients were eligible and 258 patients participated in the trial from September 2004 to July 2007.

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Patients were not enrolled because they did not attend their scheduled clinic visit ($n = 75$), had no time to be enrolled on the day approached ($n = 58$), or refused ($n = 59$). Of the 258 enrolled patients, only two did not have at least one repeat AQLQ measurement and were not included in the present analysis. These two patients were younger and had better AQLQ scores and greater kcal/week at enrollment.

The 256 patients included in this analysis had a mean age of 43 years, 75% were women, and 39% had a high school education or less (Table 1). The mean body mass index was 29 kg/m^2 and 40% were obese. Eleven percent had a chronic comorbid condition, mostly diabetes mellitus, and 20% had a positive screen for depression. According to the ACQ, asthma was well controlled in 38% and not well controlled in 40%. Asthma severity ranged from mild to moderate; 86% had an SOA score ≤ 10 and no patient had a score >19. Thirty-five percent had a history of smoking and 11% were current smokers. Not all patients were taking medications as prescribed. Overall, 6% reported not taking any asthma medications, 42% reported taking only inhaled beta-agonists, and 52% reported taking some type of maintenance medication. Fifty-four percent reported that exercise triggered asthma symptoms. The mean and median self-management knowledge scores (ASMQ) were approximately 60.

The mean time in the study was 12 ± 1 month; 91% had all three repeat AQLQ measurements, 7% had two, and 2% had one. Ten patients had measurements at 6 instead of 4 months, and eight had measurements at 10 instead of 8 months. The enrollment AQLQ mean score was 5.0 ± 1.3, and this increased to 5.9 ± 1.1 at 4 months and was sustained through 12 months (Figure 1). At enrollment, energy expenditure was 1795 ± 1640 kcal/week and increased by a mean of 412 kcal/week at 12 months, corresponding to a clinically important change (Figure 1). Most kcal/week derived from walking with only 44–54% of patients engaged in any formal exercise at any time during the study. Correlation coefficients between AQLQ scores and kcal/week were relatively constant at approximately 0.35 ($p < .0001$) at each time point.

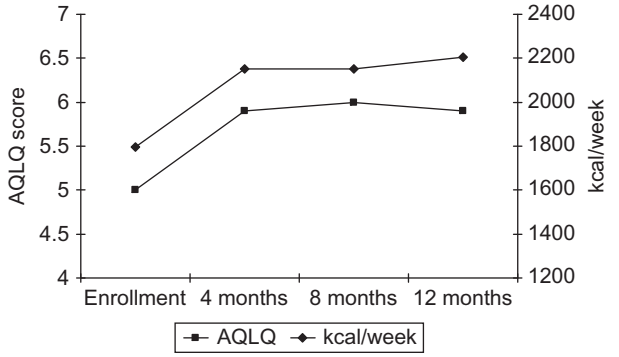


FIGURE 1.—Scores from the AQLQ and kcal/week from the Paffenbarger Physical Activity and Exercise Index.

In a mixed effects model, variables associated with improvement in AQLQ score were male sex, having less severe asthma, not taking maintenance asthma medications at enrollment, not smoking, having fewer depressive symptoms, and increasing kcal/week energy expenditure during the trial (Table 2). There were no differences based on whether the patients took the same or fewer maintenance medications (87%) or more medications (13%) at 12 months compared to at enrollment. In addition, there were no differences in AQLQ scores based on which group the patients were randomized to for the physical activity trial.

At 12 months, the mean asthma control score (ACQ) improved from 1.43 to 0.84 ($p < .0001$ for within-patient change). In addition, 60% had well-controlled asthma

TABLE 1.—Demographic and clinical characteristics at enrollment ($N = 256$).

Characteristic	Value
Age, years (mean ± SD)	43 ± 12
Women	75%
Race	
White	54%
African-American	22%
Asian	8%
More than one	16%
Latino	32%
High school education or less	39%
Depressive symptoms, score (mean ± SD)[a]	6.3 ± 6.4
Current smoker	11%
Duration of asthma, years (mean ± SD)	22 ± 15
Asthma control, score (mean ± SD)[b]	1.4 ± 1.2
Asthma severity, score (mean ± SD)[c]	5.9 ± 4.2
Asthma medications	
None	6%
Inhaled beta agonist only	42%
Inhaled corticosteroid	47%
Others[d]	5%
Taking any maintenance medication	52%
FEV_1 (mean ± SD)	90 ± 18%
FEV_1/FVC (mean ± SD)	100 ± 11%
Self-management knowledge, score (mean ± SD)[e]	60 ± 20
Asthma quality of life, score (mean ± SD)[f]	5.0 ± 1.3

[a]Geriatric Depression Scale, possible score 0–30, higher means more depressive symptoms.
[b]Asthma Control Questionnaire, possible score 0–6, higher means less control.
[c]Severity of Asthma Scale, possible score 0–28, higher means more severe asthma.
[d]Theophylline, cromolyn sodium, ipratropium bromide, and leukotriene modifier.
[e]Asthma Self-Management Questionnaire, possible score 0–100, higher means more knowledge.
[f]Asthma Quality of Life Questionnaire, possible score 1–7, higher means better status.

TABLE 2.—Variables associated with improvement in repeated measurement of AQLQ scores during 12 months.

	Bivariate analysis		Multivariate analysis	
Variable	Estimate	p	Estimate	p
Men	0.68	<.0001	0.49	<.0001
Fewer depressive symptoms	0.07	<.0001	0.05	<.0001
Less severe asthma	0.11	<.0001	0.08	<.0001
Not smoker	0.58	.003	0.26	.09
Not taking maintenance medications	0.53	<.0001	0.26	.01
Increase in physical activity	0.01	.0003	0.01	.03

Note: All analyses controlled for age. Time from enrollment was a fixed-time variable.

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compared to 38% at enrollment, and 21% had not well-controlled asthma compared to 40% at enrollment. In a multivariate model, improvement in ACQ score was associated with increases in kcal/week ($p = .05$), controlling for age, sex, depressive symptoms, smoking status, and asthma severity and medications. Finally, at the end of the trial, patients were asked if participation in this trial affected their asthma; 51% of the patients said that it made their asthma better, 49% of the patients said it had no effect, and none said it made their asthma worse.

Discussion

We found that asthma patients were able to increase their physical activity without exacerbating asthma, and in fact asthma improved by a clinically important difference, as measured by the AQLQ. This improvement occurred early in the trial and was sustained throughout the trial with a marked improvement in the number of patients with well-controlled asthma at the end of the trial. In addition, most of the increase in physical activity was from walking more, which patients integrated into their lifestyle and daily routines. To our knowledge, this study is the first to demonstrate that asthma patients can achieve clinically important increases in physical activity through readily accessible lifestyle activities without compromising asthma control.

At enrollment and each follow-up, we found similar associations between AQLQ scores and kcal/week values. This supports the hypothesis that there is a reciprocal relationship between these two variables. Namely, better asthma control makes it more possible for individuals to engage in physical activity, and prudent physical activity can lead to better respiratory function and reserve and fewer symptoms (21, 22). Our findings suggest that simultaneously fostering prudent physical activity and asthma self-management results in total benefits that exceed what might be expected from each intervention separately.

In addition to improved respiratory function from physical activity, what other factors might have contributed to improve asthma in our study? An important safety feature in this trial was close attention to asthma status, and thus a self-management component was integrated into all interactions with patients. This component was formulated during a prior study in which the self-management workbook and the knowledge test were developed (23). In addition to instruction at enrollment, this component entailed periodic reinforcement and asthma-related social support. Another possible explanation for improved asthma in the current trial might be the hypothesis that physical activity is a gateway to health behavior that predisposes to other healthy behaviors (24). This well-described hypothesis posits that patients who strive to be physically active also tend to adopt other healthy behaviors, such as eat a better diet, eliminate smoking, and manage stress better. It is possible that when patients expend effort to be more physically active, they also expend effort to better manage their chronic diseases.

Several demographic and clinical variables have been reported in other studies to be associated with improvement in AQLQ and thus were included in our analysis (25–31). As expected, patients with more severe asthma and those who required more asthma medications had less improvement. In another study, other investigators found that 395 patients with moderate-to-severe asthma had worse AQLQ scores that were clinically important compared to 253 patients with mild asthma; however, among the latter patients, those who required more medications also had worse scores (25). Depressive symptoms are not uncommon in asthma patients and are also associated with worse quality of life and other outcomes (26, 27). In a prior study, we found that more depressive symptoms at baseline were associated with markedly worse AQLQ scores and predicted worsening scores at 2 years (28, 29). In a large cross-sectional national asthma survey, other researchers also showed a dose–response relationship between more depressive symptoms and worse quality of life (27).

There are several limitations to this study. First, because this was not a trial to measure the effects of psychosocial interventions on asthma, we cannot conclude whether different components of the intervention affected asthma outcomes. Second, most measurements were by self-report questionnaires, and any tendency to over- or underreport most likely would have been in the same direction, thus increasing the likelihood for correlations among questionnaires. Third, in order to maintain consistency throughout the trial, the same research personnel asked the patients all the study-related questions. This may have affected the way some patients answered the close-out questions. Fourth, we cannot comment on the changes in respiratory exercise capacity or oxygen utilization, which would have required a performance-based test with physiological measurements.

Conclusion

Patients with mild-to-moderate persistent asthma were able to achieve and maintain clinically important increases in physical activity, while sustaining and improving asthma quality of life and asthma control. These gains were made in the setting of a self-management program that is simple to administer and reinforce. Future research objectives include measuring the physiological respiratory changes in relation to physical activity and measuring the long-term health benefits of physical activity for asthma and other health outcomes.

Declaration of Interest

None of the authors has any interest to declare. This article was written exclusively by the authors. The work described in this article was funded by R01 HL075893 from the National Heart Lung and Blood Institute.

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