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Breathing exercises in older adults with asthma: a single-blinded, randomized controlled trial

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Abstract

Objective: Breathing exercises have been found to benefit patients with some respiratory disorders, but can take a significant amount of time to complete. The effects of a breathing exercise program for older adults is unknown. The aim of this study was to evaluate the effectiveness of a short multi-component exercise program for older adults with asthma. **Methods:** To be included, subjects were age 65 years or older with persistent asthma. 90 subjects with predominantly moderate to severe asthma were randomized, 45 each, into either the exercise or control groups. After in person training at the initial visit, those in the exercise group performed a short three-part exercise program twice per day at home for one month. Those in the control group performed 2 breaths with the incentive spirometer twice per day. At the initial visit patients completed baseline questionnaires assessing demographic information, asthma control (Asthma Control Test – ACT) and quality of life (mini-Asthma Quality of Life Questionnaire – mini-AQLQ) as well as spirometry. After the one-month period at the follow up visit the ACT, mini-AQLQ, and spirometry were repeated. **Results:** Subjects in the intervention felt that the breathing exercise were helpful, and 87% would recommend them to a friend. Although both groups had improvement in ACT and mini-AQLQ, there were no differences between groups. FEV1 was lower in both groups. **Conclusion:** Although a short breathing exercise program was acceptable for older adults with asthma, it did not produce meaningful improvements in asthma outcomes. A longer program may be necessary.

Keywords asthma; geriatric; breathing exercises; quality of life; alternative medicine; treatment

Introduction

According to the CDC it is estimated that 3.5 million adults greater than 65 years of age have asthma in the United States.¹ Due to comorbidities that may confound the diagnosis, as well as bias among health care providers that all asthma begins in childhood, seniors with asthma may actually be under-diagnosed.² Older adults with asthma are at particularly high risk for having more frequent and longer hospitalization compared to other age groups and mortality increases with age.^{3,4} Even with a high estimated prevalence and worse outcomes this vulnerable population is under-researched.⁵

Though pharmacotherapy is still the mainstay of asthma treatment, there is a high level of interest in complementary and alternative medicine, particularly in older adults.⁶ Several recent Cochrane reviews found evidence that breathing exercises may lead to improvement in asthma control and quality of life^{7,8} and a small randomized trial in India showed a significant increase in lung function after a single episode of 10 min of specialized breathing exercises.⁹

Techniques such as abdominal or diaphragmatic breathing and pursed lip breathing have been a component of pulmonary rehabilitation programs for patients with COPD and asthma and in some

studies have been shown to decrease self-reported asthma attack intensity, decrease medication use, increase physical activity, and improve quality of life.^{10,11}

Our prior research in a general adult population showed a modified achievable breathing exercise program improved subjective perception of asthma control and that these exercises allowed for decreased use of rescue inhaler and improved daily activity.¹¹ However this small study was limited by its lack of a placebo group which may obfuscate the true effectiveness of the program.

There have been few randomized controlled trials to investigate the effectiveness of breathing exercises for patients with asthma, and none in older adults. Previous trials often involved breathing exercise regimens that are time consuming and may be unrealistic for many people to incorporate into their daily routines.⁸

Methods

Our hypothesis was that a short multi-component breathing exercise routine as an adjunctive intervention for adults over age 65 years old with persistent asthma would improve asthma control and quality of life as measured by the ACT and mini-AQLQ.

Study Participants

Subjects aged 65 or older with current diagnosis of persistent asthma were eligible to participate. Persistent asthma was defined as the need for a controller medication every day for asthma. Demonstration of airway reversibility was not required as chronic asthma, especially in the elderly, may be associated with a loss of response to bronchodilators. Subjects were excluded if they were current smokers or had a greater than 20 pack-year smoking history; they had any other significant pulmonary disease such as lung cancer or significant cognitive impairment such that remembering or understanding the exercises would be difficult; they had inability to communicate in English, or were currently participating in another research study or were already performing breathing exercises independently. Subjects were identified via a medical records search at University of Michigan Medical Center and were sent a letter inviting participation. Those people who did not explicitly opt out after receiving the letter were contacted a maximum of two more times by telephone to invite participation. This study was reviewed and approved by the Institutional Review Board, and all subjects provided written informed consent prior to enrollment.

In person visits were conducted at an outpatient medical clinic. At baseline, demographic information was collected. This included age, sex, age at asthma diagnosis, race, body mass index (BMI), education, number of other chronic medical conditions, and number of other medications. Additional information was collected related to asthma and included: hospitalizations, emergency department (ED) visits, and unscheduled office visits for asthma, oral corticosteroid use in the past year, asthma control as measured by the Asthma Control Test (ACT), and asthma quality of life as measured by the mini-Asthma Quality of Life Questionnaire (mini-AQLQ). Asthma severity was defined based on the number and types of asthma medication. Asthma was defined as mild for subjects on Inhaled Corticosteroid (ICS) monotherapy, moderate if requiring an ICS plus one additional medication, and severe if they required daily oral corticosteroid for their asthma or ICS plus two additional medications.¹² Baseline objective measurement included spirometric values (EasyOne Spirometer, mdd Medical Technologies, Andover, MD). See Table 1 for baseline characteristics.

Enrollment and Randomization

This study was a randomized controlled trial in which one group was asked to perform breathing exercises and a control group was given an incentive spirometer. Subjects were enrolled on an ongoing basis over a 6-month period between September 2019 and February 2020 and were randomized to either the control or intervention groups based on an alternating pattern of assignment at the time they called to schedule their initial appointment. Subjects were blinded however; study investigators were not.

Intervention

Patients assigned to the intervention group were taught a breathing exercise program which incorporated three types of breathing techniques (a yoga technique called villoma pranayama, diaphragmatic breathing, and pursed lip breathing). This program was developed by a multi-disciplinary team of asthma and pulmonary specialists including medical doctors, speech pathologists, and respiratory therapists, with the intention of creating a simple and short routine (taking less than 10 min per day) which could be realistically integrated into a daily routine. Each subject received in-person teaching at their first visit by the same study investigator. This investigator is both a medical doctor and also a physical therapist and was trained in these techniques by the program designers. Each subject also received a breathing exercise brochure containing detailed instructions and pictures of the techniques. Subjects were asked to repeat each exercise five times in the morning and five times in the evening for a one-month period at home. They were instructed to perform the exercises in a seated position, except the diaphragmatic breathing which could be completed in either seated or recumbent position based on the subject's preference. They were asked to conduct the exercises "in a comfortable environment" but no other instructions were given regarding the setting. Subjects did not receive reminders or have any further contact with investigators over the one-month study period, until their return appointment.

Subjects in the control group were given an incentive spirometer and received instruction on its use. They were asked to perform one breath with it twice per day for the one-month study period. The incentive spirometer was chosen for the control group as it was felt to improve subject blinding to treatment/sham arm while not providing any intervention that may improve outcomes.

Breathing Exercises

1. Viloma pranayama
2. Subjects were asked to inhale deeply through the nose and then exhale with pauses forcefully through their mouth. During exhalation, their mouth was partially open, and their lips sealed around their teeth to create some resistance. Next, subjects were asked to inhale through the nose with pauses and exhale normally. Finally, subjects were asked to inhale and exhale through the nose with pauses for both inhalation and exhalation.
3. Diaphragmatic breathing
4. Subjects were asked to place one hand just below their rib cage and then inhale through their nose while trying to push out the hand that is over the stomach. For exhalation, they were asked to tighten their abdominal muscles, letting them fall inward as they exhale through pursed lips.
5. Pursed lip breathing
6. Subjects were instructed to inhale slowly through their nose for several counts while keeping their mouth closed. Then they were told to hold their breath for a few seconds, and then exhale slowly and gently through pursed lips. Exhaling should be slower and longer than inhaling.

Outcome measures

Subjects were asked to perform the breathing exercises or incentive spirometer breaths for 1 month at home. The primary outcome of the study was the ACT questionnaire, which is a common patient administered questionnaire used to determine asthma symptom control. Secondary outcomes were mini-AQLQ, which is an asthma specific health-related quality of life instrument, and spirometric measures. After one month, subjects returned for the follow-up visit where they repeated the ACT and mini-AQLQ questionnaires as well as spirometry. Spirometry was performed by the same physician investigator throughout the trial for all patients at all visits. The subjects in the intervention group also answered several questions about their experience performing the exercises.

Statistical Analysis

In a pilot study improvement was noted in the ACT score of 2.3 points in those doing breathing exercises 3 or more days per week. Therefore, assuming there would be no improvement in the control group, with 80% power and α of 0.05, we calculated that 90 subjects would be adequate.¹¹ An intention to treat analysis was conducted. Data were analyzed using SPSS for descriptive statistics including frequency analysis as well as independent sample t-test. We intended to include all baseline variables in a regression model, had a difference been found on our initial bivariate analysis. As no difference was found, no regression analysis was completed for this study.

Results

Patients over age 65-years with asthma were identified via a database search and 595 subjects were screened for participation. 241 subjects declined to participate and another 264 were excluded due to exclusion criteria. The most common reason that potential subjects gave for declining was lack of time to participate in research. Of the subjects excluded, 94 had memory or cognitive impairment, 84 were current smokers or had a history of greater than 20 pack years of smoking, 47 could not easily communicate in English, 29 had other significant underlying lung disease, five were participating in other research studies, and five were already using a breathing exercise program.

A total of 90 subjects qualified and agreed to participate. 45 subjects were randomized each to the intervention and control group, with 38 and 41 subjects completing the study respectively (figure 1). The mean age of subjects in the intervention group was 73 years (SD 4.88) and in the control group was 74 years (SD 5.27). Both groups contained predominantly white female subjects, who were overall well educated. More subjects had either moderate or severe asthma compared to mild in both groups. Overall baseline characteristics, ACT, and mini AQLQ were similar between groups as shown in Table 1.

At one month, improvements were seen in both the intervention and control groups. However, no significant differences were found between groups for any of the outcomes (Table 2). The ACT showed a mean increase in total score of 1.3 (SD 4.6) in the intervention and 1.02 (SD 4.2) in the control group while the mini-AQLQ showed a mean increase of 3.9 (SD 13.6) and 5.9 (SD 14) in the intervention and control groups respectively. For both groups the improvement in subjective outcomes were accompanied by a reduction of objective lung function as measured by percent predicted of FEV1. As such our hypothesis could not be confirmed and a short breathing exercise routine was not found to improve asthma control or quality of life in older adults with asthma.

Of the 38 subjects in the intervention group who completed the follow-up visit, 32 (84%) reported that they would continue to perform the exercises, four reported that they would not continue, and two did not answer the question. Additionally, in the intervention group, 33 (87%) subjects reported that they would recommend the exercise program to a friend, 3 would not recommend it, and 2 did not answer the question. Of the 3 that would not recommend it, one stated

that they felt it was not effective, the other participants did not comment regarding reasons why they would not recommend it.

Discussion

There is a high level of interest in complementary and alternative medicine in older adults with asthma. Though pharmacotherapy is still the main stay of treatment for asthma, older adults are at particular risk for polypharmacy and adverse effects of medications.¹³ There is currently a paucity of research surrounding alternative interventions in this age group. The program developed for this study was acceptable to the majority of subjects, and nearly 90% would recommend them to a friend. However, this randomized controlled study of simple, relatively quick, breathing exercises for asthma in older adults failed to show a difference between intervention and control groups.

There may be several explanations for the ineffectiveness of our intervention. The extent of our routine may not have been significant enough to achieve a superior outcome compared to the control group. While some breathing exercise routines can take up to 45 min per day to complete,⁸ our intervention was specifically designed to be an achievable daily routine taking less than 10 min per day. This amount of time may have been insufficient. Additionally, to keep study related work to a minimum we did not require a diary or other measure of compliance. Therefore, we cannot know if lack of adherence to the intended program contributed to our findings.

Another limitation was that no objective measure was required for asthma diagnosis. Reversibility is sometimes considered not reliable in older adults which adds to the complexity of studying this population. When studying asthma in this age group there is a possibility that patients with COPD or asthma/COPD overlap could have been included.¹⁴ The effectiveness of breathing exercises may also change with age of the participant. Younger people with asthma often have more reversibility and less lung remodeling which could make exercises more efficacious in that age group.¹⁵ Moreover the intervention period of 1 month may have been insufficient to show an effect. Finally, our subjects also tended to have moderate or severe asthma and breathing exercises may be less effective for these more significantly affected patients.

Alternatively, the outcome measures themselves may have been flawed or insufficient to measure relative changes between groups or perhaps these data may support prior findings which emphasize the placebo effect on subjective measures of asthma control. The distinct impact of the placebo effect on asthma is important to keep in mind in the assessment of alternative interventions. Subjective measures of asthma control are consistently impacted by the placebo effect, while objective assessments, such as lung function, generally remain less changed,¹⁶ consistent with our results. Lastly our study was conducted over a 6-month period, while subjects were randomized by alternation, the change in seasons and environmental triggers may have affected our outcome in ways that were difficult to measure.

An important finding in the study was the difficulty in enrollment of older adults for a breathing exercise program. Due to comorbidities and transportation concerns, any intervention for older adults can be problematic. This is especially magnified in locations with winter weather, such as Michigan. Currently many medical and other industries are starting to explore alternative means of participation in their services such as video calling and online surveys. However, technology can pose its own difficulty for the current geriatric population. As current adults age these technologies may become more relevant to caring for and studying older adults. Many patients had to be excluded due to cognitive impairment. Cognitive impairment is estimated to be as high as 15–20% in persons over 60 years old,¹⁷ this may be a barrier to the usefulness of behavioral techniques for asthma treatment in older adults.

In conclusion, although there is a high level of interest in complimentary medicine and techniques, this randomized controlled trial was unable to demonstrate improved outcomes in older adults with persistent asthma. Given that the subjects in this study almost universally found breathing exercises to be subjectively beneficial, and the side effects for such interventions are minimal, these findings merit further investigation, perhaps utilizing a more intensive program in dedicated participants.

Declaration of interest

The authors report no conflicts of interest.

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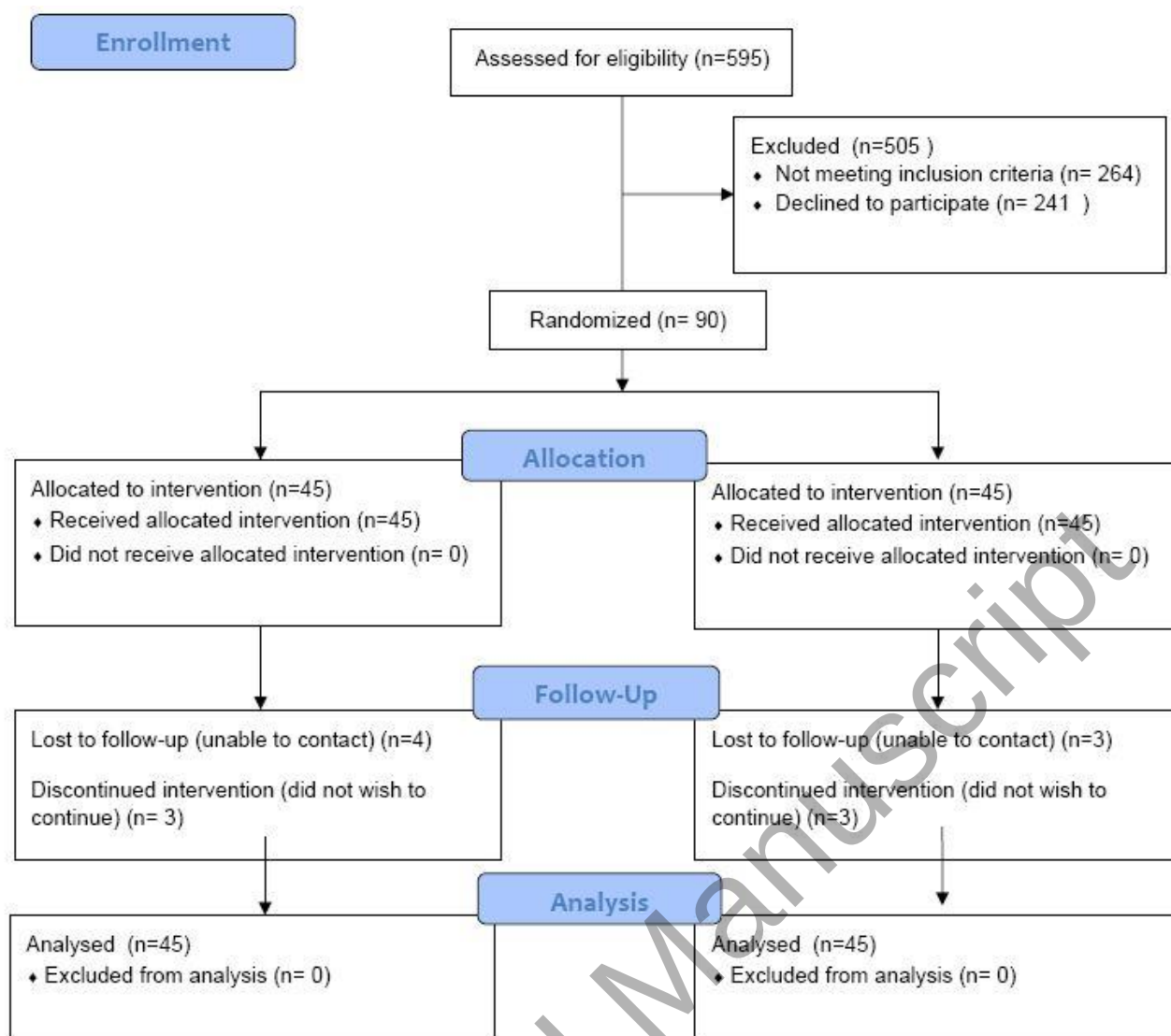


Figure 1. Flow Diagram.

Table 1. Baseline Characteristics of Participants.

	Intervention Group (n = 45)	Control Group (n = 45)	
Age (years)*	72.57 (4.88)	73.77 (5.27) <i>This isn't in the data you sent me</i> <i>p = 0.266</i>	<i>P = 0.266</i>
Male %	26 (12)	35(16) <i>P = 0.362</i>	<i>P = 0.36</i>
Race/ethnicity			<i>P = 0.367</i>
White	84 (38)	89 (40)	
Black	9 (4)	11 (5)	
Hispanic	2 (1)	0	
Other	4 (2)	0	
Education			<i>P = 0.421</i>
< High school	2 (1)	0	
High school or GED	11 (5)	20 (9)	
Some college	20 (9)	13 (6)	
College	29 (13)	42 (19)	
Postgraduate	38 (17)	47 (21)	
Other chronic conditions*	4.7 (2.1)	4.8 (1.9)	<i>P = 0.972</i>
Number of medications ^*	5.7 (4.4)	6 (4.8)	<i>P = 0.784</i>
Age at asthma diagnosis (years)*	33.6 (21.7)	32.3 (23.4)	<i>P = 0.791</i>
Urgent visits in past 12 months*	0.38 (0.90)	0.33 (1.58)	<i>P = 0.843</i>
Courses of oral corticosteroids in past 12 months*	0.44 (0.79)	0.45 (0.91)	<i>P = 0.328</i>
Asthma Severity			<i>P = 0.286</i>
Mild	24 (11)	22 (10)	
Moderate	44 (20)	31 (14)	
Severe	31 (14)	47 (21)	
Ever smoker	31 (14)	38 (17)	<i>P = 0.456</i>
ACT*	18.6 (4.6)	19.1 (4.3)	<i>P = 0.592</i>
mini AQLQ*	76.2 (18.2)	78.1 (17.9)	<i>P = 0.198</i>
FEV1 % predicted*	76.6 (18.7)	79.7 (21.7)	<i>P = 0.469</i>
FEV1/FVC*	70.1 (8.9)	67.3 (14.3)	<i>P = 0.267</i>

Data presented as %(n) unless otherwise noted.

*Mean (SD).

^Mean number of medications excluding asthma medications.

Table 2. Outcome measures at follow up visit.

	Intervention Group	Control Group	p-Value
Change in ACT	1.3 (4.6)	1.02 (4.2)	0.78
Change in mini AQLQ	3.9 (15.6)	5.9 (14.0)	0.56
Change in FEV1%	-6.5 (14)	-7.3 (15.8)	0.819
Change in FEV1/FVC	1.2 (3.9)	-0.21 (16.9)	0.73

Data is presented as mean (SD).