Usefulness of harmonica playing to improve outcomes in patients with chronic obstructive pulmonary disease

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ABSTRACT

Pulmonary rehabilitation in chronic obstructive pulmonary disease (COPD) includes a multidisciplinary approach of exercise and pursed-lip diaphragmatic breathing. Pursed-lip diaphragmatic breathing reduces alveolar collapse during exhalation, and diaphragmatic breathing improves inspiratory pressures. Harmonica playing has maneuvers similar to those taught in pursed-lip diaphragmatic breathing, with diaphragmatic breathing to create musical tones. Hence, we designed a trial to determine whether patients with COPD would benefit from harmonica playing. COPD patients who completed pulmonary rehabilitation at least 6 months prior were eligible for this trial. Patients attended 12 weeks of harmonica training sessions for 2 hours a week and were encouraged to practice at home. Participants completed pre- and postspirometry testing, maximum inspired and expired pressure (P_{lmax}, P_{Emax}) testing, and 6-minute walk tests. Eleven of the 14 participants completed the 12-week trial. P_{lmax} and P_{Emax} increased by an average of 15.4 ± 12.0 cm H₂O ($P = 0.0017$) and 14.4 ± 14.0 cm H₂O ($P = 0.0061$), respectively. Additionally, 6-minute walk distance increased by approximately 60 m (61 ± 78 , $P = 0.03$). This pilot study showed that a 12-week harmonica program significantly improved P_{lmax}, P_{Emax}, and 6-minute walk distance in COPD patients after rehabilitation. Larger-scale harmonica studies are warranted to evaluate this program's adjunctive potential benefit to formal pulmonary rehabilitation.

KEYWORDS Breathing exercises; chronic obstructive pulmonary disease; dyspnea; harmonica playing; music therapy; pulmonary rehabilitation; respiratory therapy; shortness of breath; six-minute walk; spirometry

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death in the US, affecting 16 million Americans.¹ It is preventable and treatable but commonly misdiagnosed due to a lack of spirometry testing for symptomatic patients.² Primary interventions for COPD include smoking cessation, appropriate inhaler therapy, oxygen therapy, and pulmonary rehabilitation (PR). Breathing retraining exercises such as pursed-lip breathing and inspiratory muscle training are commonly taught during PR, to reduce alveolar collapse during exhalation and improve inspiratory pressures.³ Harmonica playing requires the practice of an expiratory maneuver similar to pursed-lip breathing and diaphragmatic breathing; in addition, it mimics inspiratory muscle training

by having the patient breathe through a restrictive device to exercise the respiratory muscles.³ This article presents findings from our pilot trial of COPD patients who underwent a 12-week program of harmonica playing.

METHODS

COPD patients aged ≥ 45 years who completed a PR program at least 6 months prior were eligible for this trial. After providing informed consent, patients were scheduled for an individual evaluation and assessment by a registered respiratory therapist and a music therapist. The respiratory therapist conducted diagnostic testing according to American Thoracic Society guidelines, including the 6-minute walk distance test,

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Table 1. Demographic and clinical characteristics of participants incorporating harmonica playing

Patient	Age	Gender	Smoking pack-years	Oxygen L/min	Follow up	Cough type			GOLD classification of airflow limitations		
						Baseline	12 wk	6 mo	Baseline	12 wk	6 mo
1	69	Female	80	4	6 mo	Productive	Productive	Productive	Severe	Very severe	Very severe
2	71	Female	0	0	6 mo	Nonproductive	Nonproductive	Nonproductive	Severe	Mild	Severe
3	75	Male	40	3	6 mo	Productive	Productive	Productive	Very severe	Very severe	Very severe
4	71	Female	40	0	12 wk	Nonproductive	Nonproductive	–	Severe	Severe	–
5	67	Female	30	0	6 mo	Nonproductive	Nonproductive	Productive	Moderate	Moderate	Moderate
6	81	Female	40	6	12 wk	Nonproductive	Nonproductive	–	Severe	Severe	–
7	70	Male	30	4	12 wk	Productive	Productive	–	Very severe	Very severe	–
8	61	Male	0	2	6 mo	Productive	Productive	Productive	Very severe	Severe	Very severe
9	74	Female	60	2	12 wk	Productive	Nonproductive	–	Very severe	Very severe	–
10	80	Female	30	0	6 mo	Nonproductive	Productive	Nonproductive	Moderate	Severe	Severe
11	78	Female	30	0	6 mo	Nonproductive	Nonproductive	Nonproductive	Very severe	Very severe	Very severe

GOLD indicates Global Initiative for Chronic Obstructive Lung Disease.

spirometry, and measurement of maximal inspiratory/expiratory muscle strength. The series of questionnaires administered included the COPD Assessment Test, St. George Respiratory Questionnaire–Quality of Life, Modified Medical Research Council Dyspnea Scale, Borg Scale of Perceived Exertion, and Patient Health Questionnaire (PHQ-9) depression test. In addition, the respiratory therapist recorded patient-reported smoking and medication history, exacerbations during the past year, and number of hospitalizations. The music therapist evaluated the subjects' ability to make sound and play the harmonica.

The harmonica-playing lessons were administered via group sessions. During these sessions, the respiratory therapist educated subjects about COPD; breathing techniques for playing the harmonica; harmonica care, cleanliness, and infection control; airway clearance techniques; pacing/resting with activity; and oxygen therapy. Patients with prescribed oxygen therapy were provided continuous oxygen therapy via nasal cannula during the harmonica group classes and during the pre- and post-group class evaluations. Throughout class, patients were coached to achieve ideal harmonica-playing posture and relaxation techniques of shrugging their shoulders, relaxing their mouth muscles, and taking in a deep breath and letting it out slowly. These techniques were effective in helping them relax and reduced their anxiety. We observed lowering of their shoulders, softened facial features, and an overall relaxed body position. The participants commented that it was much easier to play the harmonica and make sound when they were more relaxed.

The completed trial included 12 weekly training sessions, followed by an optional 6-month follow up visit. During visit 1 (on day 1), all subjects met as a group to learn more about COPD and the basics of harmonica playing. Visits 2

to 12 were also face-to-face, 1-hour group training sessions, where patients practiced one or two new songs each visit. For the harmonica training sessions, the music therapist taught the group how to correctly hold the harmonica, blow through one hole at a time, use pursed lips to generate enough expiratory and inspiratory effort to make sound, and play together as a group. A big-screen television was used to project the music while the music therapist sang along as the group played. The music displayed on the screen also contained up and down arrows to indicate blows and draws, respectively, numbers indicating which hole to use, and commas indicating time to catch a breath. The music therapist used a baton to point to each note or symbol to help pace the group as they played. Participants were encouraged to continue the daily practice throughout the program and to continue playing on their own after program completion.

Participants were retested at the end of 12 weeks of training, repeating all diagnostic tests and questionnaires that included spirometry testing, maximum inspired pressure testing (P_Imax), maximum expired pressure testing (P_Emax), and 6-minute walk distance test. After the trial, participants were encouraged to continue playing on their own for another 6 months for at least 5 days a week and for at least 30 minutes a day. At the end of the 6-month period, participants were retested using the same evaluation and tests. All results were collected in a database.

Statistical analysis was performed using SAS 9.4. Due to the small sample size, mean and standard deviation measurements were used for numeric variables. A paired *t* test, to estimate the means, standard deviations, confidence intervals, and *P* values, was used to assess the differences of the last training session of the trial from the baseline, as well as the differences between the optional 6-month assessment from the baseline.

Table 2. Maximum inspired and expired pressure and 6-minute walk test results for participants incorporating harmonica playing

Patient	PI _{max} (cm H ₂ O)			PE _{max} (cm H ₂ O)			FEV ₁ /FVC (%)			Six-minute walk test (m)			Six-min walk oxygen (L/min)		
	Baseline	12 wk	6 mo	Baseline	12 wk	6 mo	Baseline	12 wk	6 mo	Baseline	12 wk	6 mo	Baseline	12 wk	6 mo
1	40	44	48	46	78	82	52	46	43	183	224	256	4	4	4
2	60	88	88	80	90	100	56	58	51	146	165	311	0	0	0
3	50	60	78	60	62	90	35	32	28	206	304	293	4	6	5
4	80	82	—	80	84	—	47	43	—	314	396	—	0	0	—
5	100	120	118	70	100	86	66	72	66	263	396	396	0	0	0
6	45	80	—	60	64	—	43	42	—	54	87	—	6	6	—
7	44	60	—	78	80	—	51	30	—	244	213	—	4	4	—
8	60	90	90	80	118	94	49	51	48	287	335	457	2	2	3
9	60	78	—	60	80	—	35	29	—	132	293	—	3	3	—
10	44	50	82	44	60	80	38	51	52	237	152	256	0	0	0
11	38	38	42	20	20	42	38	35	37	234	—	305	0	—	0

FEV₁/FVC indicates forced expiratory volume in 1 second/forced vital capacity; PE_{max}, maximum expired pressure; PI_{max}, maximum inspired pressure.

RESULTS

Fourteen participants began the trial. Three withdrew, one voluntarily and two because of their medical condition. Eleven (79%) completed all 12 harmonica training sessions. Of these, six were on continuous oxygen therapy (*Table 1*). Seven participants (64%) returned after the harmonica trial completion for the optional 6-month follow-up visit, reporting that they continued practicing the harmonica independently during those 6 months.

The average age of those completing the 12 training sessions for the trial was 73.0 ± 6.0 years, and three (27%) of them were male. All 11 participants had been smokers previously, with a median 40 pack-year (interquartile range [IQR], 10) smoking history (*Table 1*). At the end of the 12 training sessions, there was a significant improvement in the PI_{max} and PE_{max}, by an average of 15.4 ± 12.0 cm H₂O (95% confidence interval [CI] 7.3 to 23.4, $P = 0.0017$) and 14.4 ± 14.0 cm H₂O (95% CI 5.1 to 24.0, $P = 0.0061$), respectively (*Table 2*). The distance walked in 6 minutes increased by 61 ± 78 m (95% CI 8.02 to 113.1, $P = 0.03$) at the end of the 12-week training session (*Table 2*).

The 6-month follow up was an optional visit for those who wanted to assess their progress by repeating the assessments done during the study period. Only seven subjects showed up for the 6-month follow-up visit; the remaining four opted out. The average age of those returning for the 6-month follow-up was 72 ± 7 years, with a median of 30 pack-years smoked prior to quitting (IQR 10). As before, there were significant increases at 6 months from baseline in PI_{max} of 22.0 ± 12.4 cm H₂O (95% CI 10.5 to 33.5, $P = 0.0034$), PE_{max} of 25.0 ± 9.2 cm H₂O (95% CI 16.4 to 33.3, $P = 0.0034$), and 6-minute walk distance by 103 ± 56 m (95% CI 51.3 to 154.0, $P = 0.0027$) (*Table 2*).

Other assessments done during the trial included the modified Medical Research Council grade, Borg Scale of Perceived Exertion on resting, Patient Health Questionnaire (PHQ9) depression score, COPD Assessment Test score, and St. George quality of life assessments (*Tables 3 and 4*).

DISCUSSION

In this pilot trial, 11 patients with COPD completed an intervention of 12 harmonica training sessions over 12 weeks, which began at least 6 months after the completion of PR. Upon completion of the intervention, participants showed improvements in PI_{max}, PE_{max}, and 6-minute walk distance. Further, 7 (64%) participants independently continued playing the harmonica and had favorable 6-month follow-up data with sustained improvement in the assessed parameters.

Limited research exists studying the utility of harmonica playing for the treatment of COPD. PR is defined by the American Thoracic Society as “an evidence-based, multidisciplinary, and comprehensive intervention for patients with chronic respiratory diseases who are symptomatic and often have decreased daily life activities.”⁴ PR encompasses both exercise and education and has been shown to improve symptoms, quality of life, and participation in everyday activities.⁵ Canga and colleagues⁶ suggested that music therapy combined with a traditional PR program may be an effective management strategy for pulmonary disease. They examined the effect of a multimodal psycho-music therapy intervention (harmonica playing) during PR and evaluated respiratory symptoms, quality of life, and psychological well-being. Performing the harmonica training at the same time as PR exercise strength and endurance training reduced the ability

Table 3. Additional assessments of participants incorporating harmonica playing

Patient	Modified Medical Research Council grade			Borg Scale of Perceived Exertion resting score			Patient Health Questionnaire depression score			COPD Assessment Test score		
	Baseline	12 wk	6 mo	Baseline	12 wk	6 mo	Baseline	12 wk	6 mo	Baseline	12 wk	6 mo
1	1	1	1	3	2	3	1	1	1	20	9	14
2	0	0	1	1	1	2	0	0	2	1	0	5
3	1	1	2	3	2	2	0	0	2	18	13	19
4	1	1	–	1	2	–	2	1	–	24	27	–
5	1	0	1	2	2	0	1	2	2	12	7	23
6	3	3	–	3	2	–	3	0	–	12	20	–
7	4	3	–	2	2	–	3	6	–	24	22	–
8	1	1	1	2	2	3	2	0	2	21	13	19
9	4	1	–	2	2	–	13	6	–	11	11	–
10	2	3	1	2	2	2	0	2	1	10	11	3
11	1	3	2	2	2	0	0	0	0	10	5	7

Table 4. St. George Quality of Life assessments of participants incorporating harmonica playing

Patient	Symptom score			Activity score			Psychosocial score			Total score		
	Baseline	12 wk	6 mo	Baseline	12 wk	6 mo	Baseline	12 wk	6 mo	Baseline	12 wk	6 mo
1	80.6	68.17	24.9	79.88	92.51	67.76	24.63	32.22	28.63	50.67	56.46	39.88
2	6.6	6.6	20.1	17.37	12.12	47.24	14.63	26.89	7.87	14.12	19.04	21.84
3	54.48	53.41	70.5	54.3	72.89	79.67	31.67	25.16	35.4	42.32	44.32	54.65
4	70.16	88.24	–	59.46	47.69	–	39.85	31.67	–	50.83	45.92	–
5	23.03	33.51	43.6	–	22.96	66.46	17.04	21.58	17.39	12.87	23.98	36.99
6	46.91	37.51	–	66.31	79.14	–	11.86	28.74	–	34.18	45.47	–
7	62.88	66.22	–	85.81	92.51	–	45.21	47.88	–	60.45	64.45	–
8	30.4	43.74	25.4	53.62	53.62	47.69	28.01	18.09	39.97	36.17	33.12	39.89
9	31.98	36.86	–	85.87	60.38	–	34.28	27.27	–	49.54	38.9	–
10	18.66	18.66	31	66.51	66.51	85.87	22.07	22.07	28.58	34.98	34.98	46.4
11	40.94	24.29	29	41.77	47.69	60.23	8.94	8.83	6.7	24.2	23.18	26.71

to accurately quantify the effect of harmonica training alone. Their study also failed to include measures of lung function and/or muscle strength. In another study, Alexander and colleagues³ randomized COPD patients to PR only (n = 16) or PR with harmonica training (n = 9). The harmonica group was given a harmonica and one-on-one instruction only once by the PR instructor. Patients were asked to practice on their own for at least 5 minutes, but not exceeding 20 minutes twice a day for 5 days a week over a 10-week period. Participants were asked to document the amount of time practiced each day. Overall, participants had improvements in

shortness of breath, quality of life, and walking distance. However, due to the concurrent training effect of PR exercise and endurance training, it was not possible to determine the direct effect of harmonica playing. Their trial did not detect a significant difference attributable to harmonica playing over and above PR; however, the sample size was quite modest.

Our decision to limit the inclusion criteria to COPD patients who had already completed PR at least 6 months prior likely reduced the training effect that patients usually exhibit during PR with strength and endurance exercise. This enabled us to adequately assess the harmonica training

effect without confounding. Our trial demonstrates that harmonica playing in COPD patients may be used as a way for patients to improve both inspiratory and expiratory muscle strength. It can be used as an adjunct for patients undergoing PR and can also easily be done at home. As a group exercise, such an activity provides socialization and a positive outlook, along with being an uplifting pursuit for the participants. Used with strength and endurance training, breathing techniques, and patient education, harmonica playing may provide an added benefit to PR programs.

Regarding the socialization and outlook effects, some of the patients in this study continue to meet weekly at the Cvetko Center to share stories and play music together. They chose “The Harmaniacs” as a stage name for performances within the community. They have performed as a group for special occasions, such as National COPD Awareness Month, Baylor Scott & White Dallas Better Breathing Club Christmas Party, and National Pulmonary Rehabilitation Week. Not to be outdone by professional musicians, they have been the topic of conversation on local and national radio, TV, and social media. They now perform about 30 to 40 songs on a regular basis, and all have said that being a part of this group makes their lives better.

This work has limitations inherent to a small single-center trial. As such, we are uncertain about the generalizability of the results. Due to the small sample size, the statistical power was low, which makes the discovery of statistically significant improvements in the three outcome measures all the more notable. Larger-scale harmonica studies are warranted to evaluate the program’s full benefit.

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