CORRESPONDENCE

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A Pilot Randomized Controlled Trial of an Intervention to Improve Perception of Lung Function in Older Adults with Asthma

To the Editor:

Asthma affects 6–8% of the United States population aged 65 years and older (1). This age group, particularly minoritized populations, has the highest hospitalization and mortality rates for asthma (2). Older adults with asthma may be more likely to underperceive airflow obstruction (3), which is linked to an elevated risk of near-fatal and fatal asthma attacks and increased morbidity (4). Correction of underperception of airflow obstruction in children through training to estimate peak expiratory flow (PEF) followed by feedback of seeing actual PEF led to improved controller medication adherence (5). However, there are no data regarding the potential benefits of addressing underperception in older adults.

The objective of this pilot randomized controlled trial was to compare PEF feedback combined with motivational interviewing (MI), a counseling intervention for eliciting behavior change by helping patients explore and resolve ambivalence (6), to a control group on the perception of airway obstruction (primary endpoint), PEF values, self-reported asthma control, and medication adherence.

Methods

We conducted a pilot trial with 53 participants 60 years or older with a physician diagnosis of asthma from hospital-based clinics in the Bronx and East Harlem, New York. Participants with underperception of airflow obstruction 25% of the time or higher were recruited from a longitudinal, observational study (*see* parent study [7]). Participants who spoke English or Spanish and were prescribed an asthma controller medication were eligible. Exclusion criteria included dementia, other chronic respiratory illness, smoking 15 or more pack-years, and moderate/severe cardiac disease.

Preintervention perception of airflow obstruction was on the basis of 6 weeks of home data collection consisting of twice daily PEF prediction into a programmable peak flow monitor (PFM; AM2, Clario) immediately followed by a PEF measurement with the same device. Participants were blinded to actual PEF. A sticker was placed on the PFM depicting each participant's predicted PEF values for green, yellow, and red zones of asthma control. Each guess and actual PEF were converted into either accurate (within 10% of actual values), underperception, or overperception blows on the basis of color zones for PEF predictions and actual PEF.

Participants were randomized into PEF feedback with MI or supportive counseling without PEF feedback, both delivered in person during a 45-minute session with an interventionist that included asthma education. During the PEF feedback session, interventionists reviewed each participant's perception data, helping them differentiate times of accuracy versus underperception or overperception. MI strategies focused on behavior change to improve asthma control by making connections between PEF values, asthma symptoms, triggers, asthma control, and the role of controller medications. The PFM was reprogrammed at this session to enable participants in the intervention arm for the following 4 weeks to see actual PEF immediately after PEF predictions were locked in.

The control group session included supportive counseling surrounding asthma management, including empathy for struggles with asthma, praise for good asthma control, and encouraging a positive attitude. The PFM was reprogrammed for participants over the next 4 weeks to receive a positive message ("Great job for remembering to use your peak flow meter!") after PEF predictions instead of seeing actual PEF values.

All participants were asked twice daily to conduct PEF predictions and blows at home.

A postintervention visit took place 1 month later to download perception data and reprogram the PFM to blind all participants to actual PEF. Perception data were downloaded at a final 1-month follow-up.

Self-report measures at each visit included MARS (Medication Adherence Response Scale) (8), ACQ-6 (Asthma Control Questionnaire) (9), and treatment credibility and expectancy of improvement in asthma control (10). Coordinators who administered questionnaires were blinded to the treatment group. Fidelity ratings were conducted on 50% of sessions for items covered by interventionists.

Statistical analyses were performed on an intent-to-treat basis using generalized linear mixed model analyses with age, race, sex, and income as covariates. Effect sizes are reported as Cohen's *d*.

Results

The PEF feedback group consisted of 30 participants with two dropouts before completing the intervention session ($N = 28$); the control group comprised 25 participants who completed the intervention session with three dropouts after treatment. No baseline differences were found between the two groups (Table 1). A majority of the participants were female and Hispanic or Black.

The PEF feedback group displayed large decreases (Table 2) in underperception and medium increases in accurate perception from preintervention to postintervention and 1-month follow-up. Conversely, the supportive counseling group had no change in accuracy or underperception at any time point. The effect of the intervention versus control in underperception ($P = 0.053$) and accurate perception ($P = 0.065$) was just outside the range of significance in this small pilot study. Both groups had medium increases in overperception at posttreatment. PEF feedback had a large increase in PEF from preintervention to posttreatment and a medium–large increase at 1-month follow-up; these improvements were statistically significant compared with the

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Table 1. Baseline Characteristics of Participants by Randomization Group

Characteristic	PEF Feedback ($n = 28$)	Supportive Counseling ($n = 25$)	*P* Value
Age, mean (±SD)	67.0 ± 4.9	65.7 ± 5.6	0.16
Sex (female), *n* (%)	21 (75.0)	23 (92.0)	0.10
Race/ethnicity, *n* (%)			
White, non-Hispanic	5 (17.9)	4 (16.0)	0.68
Black, non-Hispanic	7 (25.0)	9 (36.0)	
Other, non-Hispanic	3 (10.7)	4 (16.0)	
Hispanic	13 (46.4)	8 (32.0)	
Monthly income, *n* (%)			
⩽$1,500	13 (52.0)	12 (54.5)	0.86
>$1,500	12 (48.0)	10 (45.5)	
Education, *n* (%)			
Less than high school	5 (18.5)	3 (12.0)	0.66
High school graduate	5 (18.5)	2 (8.0)	
Some college	8 (29.7)	9 (36.0)	
College graduate or higher degree	9 (33.3)	11 (44.0)	
Language preference, *n* (%)			
Mostly English	17 (60.7)	20 (80.0)	0.13
Mostly Spanish	6 (21.4)	1 (4.0)	
Both English and Spanish	5 (17.9)	3 (12.0)	
Mostly other language	0 (0.0)	1 (4.0)	
Smoking history, *n* (%)			
Current	2 (7.4)	3 (12.0)	0.30
Former	12 (44.4)	6 (24.0)	
Never	13 (48.2)	16 (64.0)	
Marital status, *n* (%)			
Married	13 (48.1)	4 (16.0)	0.06
Single/divorced/widowed	14 (51.9)	21 (84.0)	
Health insurance, *n* (%)			
Medicaid or Medicare	20 (74.1)	16 (72.7)	0.86
Private or other	6 (22.2)	6 (27.3)	
No insurance	1 (3.7)	0 (0.0)	
FEV_1% predicted, mean (±SD)	77.8 ± 20.1	71.8 ± 18.0	0.48
Current inhaled corticosteroid use, *n* (%)	21 (75.0)	21 (84.0)	0.42
Current leukotriene receptor antagonist use, *n* (%)	7 (25.0)	7 (28.0)	0.81

Definition of abbreviation: PEF = peak expiratory flow.

control arm ($P < 0.0001$). No within-group effects were significant for medication adherence in either group. Although not a statistically significant change, PEF feedback showed a clinically meaningful improvement in ACQ scores at follow-up (50% improvement to well-controlled). Both groups rated their intervention as highly credible, with high expectations for improvement in asthma. Treatment fidelity coding (PEF feedback: 77%; control arm: 84%; $P = 0.25$) and adherence to the protocol at home were high in both groups (number of PEF predictions–blows in PEF feedback: M = 48.8, SD = 13.0, and control arm: M = 50.6, SD = 15.7; $P = 0.685$).

Discussion

PEF feedback with a single intervention session demonstrated large effects in decreasing underperception and increasing PEF compared with supportive counseling. These changes were maintained in the intervention arm without PEF feedback across a 1-month follow-up. These findings suggest that training and feedback can decrease underperception of airflow obstruction and increase lung function in older adults with asthma. Improvement in asthma control was not statistically significant, and further studies with larger samples are needed. Increases in overperception were observed in both groups, possibly because of greater attention focused on asthma. Future studies should address this to avoid excessive quick-relief medication use. Although the mechanisms underlying the improvements in PEF were not assessed, greater adherence to controller medications (because of awareness of lack of control), increased use of smart therapy, or stepping up of asthma therapy (because of reporting more symptoms to providers) may be involved. If future research in larger samples validates these early findings, this intervention may provide new mechanisms to improve the outcomes of older patients with asthma. ■

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Table 2. Impact of the Intervention on Study Outcomes

	Preintervention *n* = 53	Postintervention *n* = 50	Cohen's *d*	1-month Follow-up *n* = 50	Cohen's *d*	Group Effect *P* Value	Time Effect *P* Value	Group × Time *P* Value
Accurate perception, %†								
PEF feedback	55.29 (6.47)	71.52 (6.35)*	0.50	72.23 (7.61)*	0.50	0.01	0.15	0.06
Supportive counseling	51.13 (6.92)	52.67 (6.39)	0.05	42.94 (8.27)	−0.23			
Underperception, %†								
PEF feedback	39.68 (6.99)	11.86 (6.40)**	−0.82	11.79 (7.38)**	−0.78	0.02	0.0001	0.05
Supportive counseling	44.95 (7.47)	33.76 (6.44)	−0.33	45.09 (8.01)	0.004			
Overperception, %†								
PEF feedback	5.03 (2.13)	16.59 (4.95)*	0.66	15.98 (5.90)	0.56	0.95	0.006	0.93
Supportive counseling	3.92 (2.28)	13.58 (4.98)*	0.54	11.98 (6.41)	0.41			
Actual PEF, % personal best								
PEF feedback	66.97 (0.42)	80.83 (0.63)***	0.76	78.63 (0.53)***	0.65	0.03	<0.0001	<0.0001
Supportive counseling	68.22 (0.55)	71.88 (0.75)***	0.19	67.68 (0.74)	−0.03			
Medication Adherence Response Scale								
PEF feedback	4.02 (0.19)	4.39 (0.16)	0.40	4.14 (0.13)	0.14	0.27	0.62	0.37
Supportive counseling	4.35 (0.21)	4.23 (0.19)	−0.12	4.40 (0.16)	0.05			
Asthma Control Questionnaire‡								
PEF feedback	1.42 (0.21)	0.92 (0.42)	−0.44	0.71 (0.29)	−0.66	0.90	0.17	0.51
Supportive counseling	1.49 (0.23)	1.10 (0.40)	−0.33	1.34 (0.32)	−0.13			
Treatment credibility								
PEF feedback	—	19.25 (1.71)	—	19.69 (1.44)	—	0.51	0.83	0.65
Supportive counseling	—	19.17 (1.47)	—	18.89 (3.69)	—			
Treatment expectancy								
PEF feedback	—	25.25 (4.59)	—	25.15 (2.73)	—	0.41	0.22	0.23
Supportive counseling	—	25.33 (4.84)	—	21.89 (8.87)	—			

For definition of abbreviation, *see* Table 1.
Table data are reported as least squares means (SE), adjusted for age, race, sex, and monthly income. Within-group comparisons are denoted by *$P < 0.05$, **$P < 0.01$, and ***$P < 0.001$ and are reported for postintervention and 1-month follow-up versus baseline.
Effect sizes reported for within-group change: Cohen's d 0.2 = small; 0.5 = medium; and 0.8 = large.
†The percentage of peak expiratory flow guesses in the accurate, underperception, and overperception zones.
‡Asthma Control Questionnaire was added later in the study to postintervention (n = 18) and 1-month follow-up (n = 21).

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Volume–OXygenation Index to Predict High-flow Nasal Cannula Failure: How to Capture the Tidal Volume Matters

To the Editor:

We read with great interest the article by Chen and colleagues (1) in which they proposed a modified novel index volume–OXygenation (VOX), as calculated using the tidal volume (VT), as compared with the original ROX index [SpO_2 (pulse oximetry)/FiO_2 over respiratory rate (RR)] with RR. Better performance with higher sensitivity and specificity and a larger area under the receiver operating curve at an earlier phase (2 h and 6 h) after high-flow nasal cannula (HFNC) was initiated. We congratulate the authors for the nicely conducted pilot study demonstrating the important role of VT in the failure of HFNC in patients with acute hypoxemic failure. Nevertheless, as pointed out by Chen and colleagues, the VT measurement with noninvasive ventilation (NIV) and interruption of HFNC was not ideal. We would like to continue the discussion on this topic.

VT Occurring During HFNC May Not Be the Same as the VT Measured During NIV

To illustrate our concern, we have conducted a similar measurement as described in the study (1). A patient with acute hypoxemic failure was treated with HFNC (Optiflow, Fisher and Paykel). HFNC was interrupted and switched to NIV (Respironics V60, Philips) with inspiratory support of 5 cm H_2O and positive end-expiratory pressure amount of 5 cm H_2O. To compare the VT during HFNC and NIV, electrical impedance tomography (EIT; PulmoVista500, Draeger Medical) was used, and the ventilation changes were tracked (2). VT during noninvasive ventilation was 640 ml on average. When the impedance changes normalized to volume, it yielded VT 472 $\pm$ 65 ml for HFNC and 640 $\pm$ 74 ml for NIV. VOX was 30.4 instead of 41.2 if VT from NIV was used instead of HFNC. The cut-off values proposed in the study by Chen and colleagues were optimized for VT measured during NIV but not for HFNC.

For the Calculation of VOX, the Absolute VT Might Not Be Necessary

One disadvantage of HFNC interruption is that the "positive pressure" effect induced by HFNC will disappear within 10 seconds (as indicated with end-expiratory lung impedance in EIT).

On the other hand, EIT can be used to identify overdistention via monitoring VT distribution during HFNC continuously (3). This provides an objective measure for real-time VT changes and respiratory rate. In a previous study, we attempted to use EIT for

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