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Quality of Life Concerns of Patients with Cardiac and Pulmonary Disorders

Effects of humor and laughter on psychological functioning, quality of life, health status, and pulmonary functioning among patients with chronic obstructive pulmonary disease: A preliminary investigation

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ABSTRACT

Objective: Previous research indicates the beneficial effects of humor among healthy adults. Little is known about the physical and psychological effects of sense of humor and laughter among patients with chronic obstructive pulmonary disease (COPD).

Methods: Patients with COPD (n = 46; mean age ± SD, 66.9 ± 9.9 years) completed assessments of sense of humor, depression, anxiety, quality of life, and recent illness. A subset of patients (n = 22) completed a laughter induction study and were randomly assigned to view either a humorous or a neutral video. Pulmonary function, mood state, and dyspnea were assessed before and after the video.

Results: Sense of humor was associated with fewer symptoms of depression and anxiety and an enhanced quality of life. However, the induction of laughter led to lung hyperinflation.

Conclusion: Sense of humor among patients with COPD is associated with positive psychological functioning and enhanced quality of life, but laughing aloud may cause acute deterioration in pulmonary function secondary to worsened hyperinflation.

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Humor has been associated with improved psychological, cardiovascular, and immune functioning among healthy adults.[1-6] The concept of humor is multifaceted and has been defined and assessed in a multitude of ways. In this investigation, "sense of humor" refers to individual differences in personality related to the perception, appreciation, expression, and use of amusement, laughter, and jocularity.[7] Researchers tend to use quantitative rather than qualitative measurements for sense of humor. For example, popular measurements of sense of humor include assessment of (1) the degree to which a person uses humor to cope with stress, (2) the frequency of smiling or laughing in a variety of situations, or (3) the amount of an individual's appreciation or production of humorous material. The term "humor" among psychology researchers can be divided into the stimulus (humor), the emotional response (mirth), and the behavioral expression (most commonly laughter).[5,7]

Individuals with a greater sense of humor report less depression, exhibit better immune functioning, and experience fewer respiratory illnesses.[3,4,8,9] In addition, previous studies found that exposing individuals to humorous stimuli was associated with enhanced mood, elevated levels of secretory immunoglobulin-A, and vasodilation.[10-12] Laughter, the most common reaction to humor, may explain some of these physiological benefits, including those associated with respiration. According to Fry, the predominance of expiration over inspiration during laughter should result in an elimination of air that accumulates in the lungs with normal breathing.[5,11,13] The expiratory component of laughter is also thought to aid in clearing respiratory secretions.[5,11]

The benefits of sense of humor and laughter may be particularly relevant for patients with chronic obstructive pulmonary disease (COPD), a progressive disease characterized by a chronic obstruction of airflow, hyperinflation of the lungs, and persistent ventilatory impairment.[14] Increased residual volume ("air-trapping") is observed in COPD because of premature airway closure and a loss of lung elasticity.[14] Recent data suggest that smiling and gentle laughter may be associated with temporary reductions in hyperinflation of the lungs among individuals with COPD compared with healthy control subjects.[15] Dyspnea, or shortness of breath, is typically the most prevalent and debilitating symptom of COPD.[14]

Psychiatric symptoms and impairment in psychological functioning are frequently observed among patients with COPD. Patients with COPD typically report impaired quality of life and increased psychological distress, with as many as 42% to 74% experiencing depression.[16-18] Anxiety is another emotional consequence of COPD, affecting as many as 67% of patients.[19,20] The presence of anxiety among patients with COPD may lead to exaggerated or catastrophic misinterpretations of bodily sensations, including dyspnea, triggering a panic reaction that may induce heightened physiological arousal. Increased arousal triggered by the panic response can lead to increased symptoms, including breathlessness, followed by a misinterpretation of the new symptoms, contributing to further anxiety.[19,21,22] The resulting dyspnea-anxiety spiral is often difficult to prevent, and may temporarily disable an individual with COPD.[17,22] However, a sense of humor and/or laughing may mitigate the negative psychological and physiological aspects of COPD.[11,15]

Two studies were conducted to evaluate (1) the relationship between sense of humor and psychological functioning, quality of life, and health status among patients with COPD, and (2) the effects of laughter on pulmonary function and mood state in patients with COPD. Study 1 was a correlational design examining the relationship between sense of humor (operationalized in this study as the use of humor as a coping strategy, and the frequency of expressing humor in daily life) and psychological functioning (operationalized by depression and anxiety), quality of life (operationalized by health-related quality of life), and health status (operationalized by recent symptoms of infectious illness) among patients with COPD. It was hypothesized that a greater sense of humor would be associated with lower levels of depression and anxiety, an elevated quality of life, and fewer recent infectious illnesses (Figure 1). Study 2 involved a randomized, controlled induction of laughter to evaluate the effects of laughter on pulmonary function and mood state among patients with COPD. Pulmonary function and mood state were assessed before and after viewing a 30-minute (humor or neutral) video presentation. Because the study sought to examine changes associated with the presence of laughter in patients with COPD, the control group for the study included patients with COPD who were exposed to an emotionally neutral video. We hypothesized that (1) the induction of laughter would be associated with improved lung volumes, as reflected by diminished "air-trapping," and specifically decreases in functional residual capacity (FRC) and residual volume (RV); (2) the induction of laughter would be associated with an improved mood state; and (3) the amount of laughter exhibited during the study would predict change in lung volumes (Figure 2). Dyspnea was measured before and after the video presentation for exploratory purposes, to assess whether laughter had an impact on dyspnea among patients with COPD.

Methods

Participants

The protocol for this study was approved by the Institutional Review Board at Ohio State University (Columbus, OH), and each participant gave informed consent. The study sample included 46 patients with

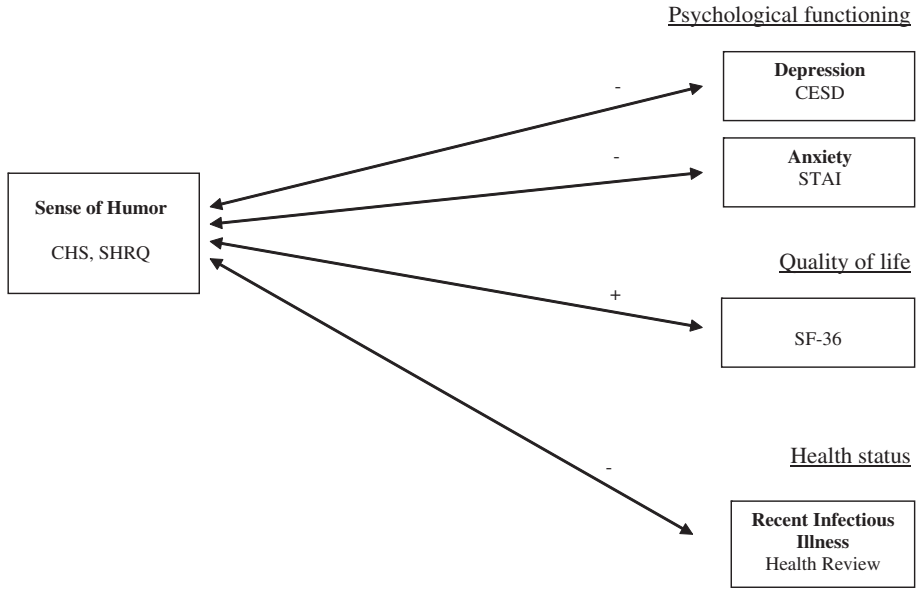

Figure 1 – Hypotheses for Study 1. *CHS*, Coping Humor Scale; *SHRQ*, Situational Humor Response Questionnaire; *CESD*, Center for Epidemiological Studies—Depression Inventory; *STAI*, State-Trait Anxiety Inventory, trait scale; *SF-36*, Medical Outcomes Study, 36-Item Short Form Health Survey.

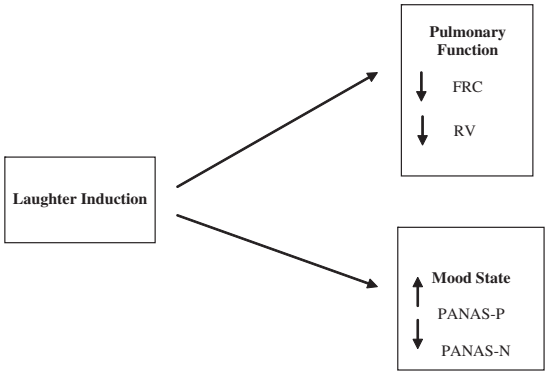

Figure 2 – Hypotheses for Study 2. *FRC*, functional residual capacity; *RV*, residual volume; *PANAS-P*, Positive and Negative Affectivity Scales, positive scale; *PANAS-N*, Positive and Negative Affectivity Scales, negative scale.

COPD (mean age ± SD, 66.9 ± 9.9 years; 59% female) recruited by advertisements and flyers posted throughout the Central Ohio community. Patients had been diagnosed with COPD for an average of 10.5 (± 8.4) years (range, 1 to 31 years). Additional demographic information is included in Table 1.

Study 1 and Study 2 were conducted sequentially in a pulmonary laboratory at the Heart and Lung Research Institute of Ohio State University Medical Center. Study 1 was completed immediately before the induction of laughter (i.e., Study 2) in the same room. A subset of patients (n = 24) chose only to participate in Study 1. Thus, only the 22 patients in Study 2 completed the assessments of pulmonary function required for the evaluation of laughter induction in Study 2. All patients in Study 2 met the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria for COPD.[14]

Study 1 Procedure

Patients completed self-report measures to assess sense of humor, psychological functioning, and quality of life, as well as a brief structured interview to summarize recent infectious illnesses. Patients were paid $15 for completing Study 1.

Study 1 Assessments

Sense of Humor

Measures of sense of humor included the Coping Humor Scale (CHS)[23] and the Situational Humor Response Questionnaire (SHRQ).[24] The 7 items of the CHS measure the degree to which an individual uses humor to cope with stress. Each item is rated on a 4-point Likert scale, with options ranging from 1 (strongly disagree) to 4 (strongly agree). An example of an item would be, "I usually look for something comical to say when I am in tense situations." Higher scores on the CHS indicate a greater use of humor as a coping strategy. The CHS demonstrates adequate internal consistency, test-retest reliability, and concurrent validity.[23-25] Based on data from Martin, item 4 from the CHS was deleted, and the measure for this study included the remaining 6 items.[8] Internal consistency for the CHS used in the present study was adequate (Cronbach's $\alpha = .73$).

Table 1 – Demographic characteristics of patients in Study 1 and Study 2

	Study 1 (n = 46)		Study 2			
			Humor (n = 12)		Neutral (n = 10)	
	n	(%)	n	(%)	n	(%)
Gender						
Male	19	(41)	4	(33)	4	(40)
Female	27	(59)	8	(67)	6	(60)
Race						
White	40	(87)	10	(83)	7	(70)
African-American	5	(11)	2	(17)	2	(20)
Hispanic	1	(2)	0	(0)	1	(10)
Smoking status (smokers)	2	(9)	2	(15)	3	(27)
	Mean	(SD)	Mean	(SD)	Mean	(SD)
Age	66.9	(9.9)	68.8	(8.1)	66.5	(9.9)
Years of education	13.4	(3.0)	14.7	(2.6)	12.7	(2.6)
Years since diagnosis	10.5	(8.4)	8.5	(7.3)	13.0	(10.0)
FEV_1/FVC	*		.52	(.20)	.52	(.14)
$FEV_1\%$	*		42.4	(17.2)	49.4	(13.7)
FVC%	*		64.8	(19.3)	76.8	(23.8)

Patients in the humor and neutral conditions did not differ with regard to demographics or baseline pulmonary function. *FEV_1*, forced expiratory volume in 1 second; *FVC*, forced vital capacity.
* Pulmonary function was not assessed in Study 1.

The SHRQ assesses the frequency of smiles, laughter, and other mirthful behaviors in a variety of situations. The measure consists of 21 items, 18 situational items, and 3 generalized self-report items. The situational items describe a particular situation, such as meeting an old acquaintance while shopping, followed by 5 response options, ranging from 1 ("I would not have been particularly amused") to 5 ("I would have laughed heartily"). The 3 general self-report items ask patients to rate their overall amusement in a variety of situations, the degree to which their amusement varies from situation to situation, and the desirability of choosing friends who are easily amused. The SHRQ demonstrates adequate reliability and validity. Measures of internal consistency ranged from .70 to .83 across samples, with a 4-week test-retest reliability of .70.[8,24] The internal consistency of the SHRQ in the present study was adequate (Cronbach's $\alpha = .80$). The SHRQ was correlated with the frequency and duration of observed laughter during an interview, peer ratings of the participant's sense of humor, and responses while performing an impromptu humor routine.[8,24]

Psychological Functioning

Psychological functioning was evaluated using measures of depression and anxiety. Depression was evaluated using the Center for Epidemiological Studies-Depression Inventory (CESD), which assesses symptoms of depression during the previous week.[26] Each of the 20 items, such as "I felt that everything that I did was an effort" and "I enjoyed life," is rated on a 4-point Likert scale, with response options ranging from 0 for "rarely or none of the time (less than 1 day)" to 3 for "most or all of the time (5 to 7 days)". Scores range from 0 to 60, with higher scores indicating greater depressive symptomatology. The CESD is a continuous measurement of depressive symptoms, and was not developed as a clinical diagnostic tool. However, a score of 16 or higher may suggest a clinically relevant depressive disorder.[26,27] Adequate internal consistency was demonstrated, with Cronbach's α reported as .87.[26] The CESD also demonstrates adequate construct validity.[26,28] The reliability for this sample was .82.

General levels of anxiety were measured via the trait subscale of the State-Trait Anxiety Inventory (STAI).[29] The trait subscale consists of 20 items that assess general feelings on a 4-point Likert scale, with response options ranging from 1 (almost never) to 4 (almost always). The scale includes items such as "I feel that difficulties are piling up so that I cannot overcome them" and "Some unimportant thought runs through my mind and bothers me." The instruction set asks respondents to indicate how they are feeling generally. The STAI demonstrated adequate reliability in older adults (Cronbach's $\alpha = .94$).[30] The reliability for this sample was .90.

Quality of Life

Quality of life was measured using the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36),[31] a standardized measure of health-related quality of life. Two composite scores (Physical and Mental) can be computed from the SF-36, with higher scores indicating more optimal functioning. Reliability coefficients for the scales range from .78 to .93, and the psychometric validity ranges from .67 to .82 across scales.[33] The SF-36 was validated in populations of medical and psychiatric patients.[32,33]

Health Status
Recent upper respiratory illness episodes were measured using a modified version of the Health Review.[34] The Health Review is a structured interview with ratings determined by a trained interviewer. The Health Review assesses illness episodes that have occurred in the previous 4 weeks, focusing on number of episodes, length of each episode, necessary treatment, and specific symptoms of each. A checklist of 13 symptoms is reviewed for each reported illness episode, assessing the presence of symptoms such as "swollen lymph glands in neck" and "increase in cough lasting at least 24 hours." The Health Review was used in this study because of its focus on respiratory infections. The present investigation focused on (1) number of infectious illness episodes in the previous month (ILLNESS-E), and (2) number of days that respiratory symptoms persisted (ILLNESS-D). The Health Review demonstrates appropriate interrater (.87) and test-retest (.76) reliability.[34] Adequate criterion validity was documented according to physicians' diagnoses and immune parameters.[34-36]

Study 2 Procedure

Study 2 included 22 older adult patients with COPD who participated in a randomized induction of laughter. This sample included a subset of patients from Study 1, all of whom were encouraged to participate, although many of them declined. The sample for Study 2 did not differ from the overall sample in any demographic variables, as shown in Table 1. Patients were asked to refrain from using any pulmonary inhalers for at least 60 minutes before arrival at the study site, but were otherwise told to follow their normal medication routines.

After giving consent, each patient completed self-report measures of mood state and dyspnea severity, followed by spirometry and lung-volume testing by body plethysmography. Each patient was then randomly assigned to a condition (Humor or Neutral) to watch a 30-minute video presentation. Because individual tastes in humor vary, patients in the Humor condition were given a choice of the presentations *Best of Abbott and Costello Live* (1995), *Bill Cosby Himself* (1983), or *Best of America's Funniest Home Videos* (1990). Patients in the Neutral condition were given a choice of 3 instructional videos on practical topics such as use of the internet or home repairs.

Patients again completed self-report measures of mood state and dyspnea after the presentation. The video presentation was divided into 2 segments of 15 minutes each, with mood state and dyspnea reassessed after 15 minutes, and pulmonary function reassessed after 30 minutes. This protocol maximized the likelihood that the experience of pulmonary function assessment would not influence measurements of mood state or dyspnea.

Patients sat in a recliner in an isolated room, with body plethysmography equipment present, so that pulmonary function could be reassessed within 2 minutes after viewing the video. A camcorder recorded patients' laughter during the video. A research assistant sat directly outside the room during the video, and additional medical personnel were available in case of an emergency (which did not occur). Research personnel were not blinded to group assignment. Patients received $25 after completing Study 2.

Study 2 Assessments

Pulmonary Function
The assessment of pulmonary function included spirometry and lung-volume measurement via body plethysmography, measured before and after the induction of laughter, according to American Thoracic Society guidelines.[37] All pulmonary-function assessments were performed using a Sensor Medics Vmax Series/6200 Autobox DL (Sensor Medics, Yorba Linda, CA). Primary outcomes of interest from the assessment of pulmonary function included forced expiratory volume in 1 second (FEV_1), forced vital capacity (FVC), FRC, and RV. Patients inhaled completely, and then exhaled into a mouthpiece as forcibly as possible. FEV_1 reflects the volume of air expelled from the lungs during the first second of maximum expiration, and FVC reflects the total amount of air expired. Airflow obstruction is indicated when the ratio of FEV_1/FVC is less than .70.[37] The FRC is the amount of air remaining in the lungs after normal exhalation, and RV is the amount of air that remains trapped in the lungs after maximum exhalation. Because the lungs of patients with COPD lose elastic recoil and thus the ability to push air out of the lungs, COPD is characterized by elevations in RV and FRC.[37]

Mood State
The Positive and Negative Affectivity Scales (PANAS) were used to assess current mood state.[38] The PANAS is a 20-item measure that assesses negative affect (PANAS-N, 10 items) and positive affect (PANAS-P, 10 items). Mood state descriptors (such as "excited," "upset," and "inspired") are rated on a 5-point Likert scale, ranging from 1 (very slightly or not at all) to 5 (extremely), to assess mood state. Patients responded to PANAS items based on how they were feeling at that moment. The PANAS demonstrates adequate reliability, ranging from .86 to .90 for positive affect, and from .84 to .87 for negative affect.[38] The reliability in this sample was .60 for PANAS-P, and .47 for PANAS-N.

Dyspnea
The severity of dyspnea was assessed using the Numeric Rating Scale (NRS), which was documented to be a valid measure of dyspnea among patients with COPD.[39] The NRS is a 1-item, self-report measure of current dyspnea. The directions read, "On a scale from 0 to 10, indicate how much shortness of breath you are having right now, with 0 = no shortness of breath, and 10 = shortness of breath as bad as can be." The NRS

demonstrated adequate concurrent validity, correlating highly with the Visual Analog Dyspnea Scale ($r = .80$ to .82).[39] It was also shown to detect change effectively in the severity of dyspnea before and after ambulation.[39]

Laughter

Laughter exhibited during the video was measured in seconds, as assessed by 2 trained research assistants who independently viewed a 30-minute recording of each patient watching the video. The average of the 2 raters was used as a measure of laughter duration. The interrater reliability was adequate ($r = .87$). Any significant discrepancy (i.e., >10% difference in rating scores) between the 2 raters resulted in a third trained rater measuring laughter and then using the average of the 2 closest ratings. Only 2 of the ratings were discrepant and required a third rater.

Data Analysis

In Study 1, correlational analyses were conducted for each of the 2 sense-of-humor measures (CHS and SHRQ) with each of the dependent variables: psychological functioning (CESD and STAI), quality of life (SF-36), and health status (ILLNESS-E and ILLNESS-D).

The primary mode of analyzing data in Study 2 was a 2 × 2 (group × time) repeated-measures analysis of variance (ANOVA), with group assignment (humor vs. neutral) as the between-subjects variable and time (baseline vs. recovery) as the within-subjects variable. A repeated-measures ANOVA was conducted for the variables of pulmonary function (FRC and RV), mood state (PANAS-P and PANAS-N), and dyspnea.

In addition, a hierarchical regression analysis was used to evaluate the extent to which laughter contributed to changes in pulmonary function. For each regression analysis, the dependent variable was pulmonary function at recovery (FRC or RV). Pulmonary function at baseline and seconds of laughter were entered in steps 1 and 2, respectively, as independent variables.

Results

Study 1

Patients reported using a sense of humor in their daily lives. The CHS measures the use of humor as a method of coping with stress. The SHRQ measures the frequency of mirthful behaviors, e.g.,laughter. Out of a possible score of 24, the mean ± SD CHS score in this sample was 19.3 (± 3.4). The mean SHRQ score was 56.6 (± 9.2) out of a possible 105. This pattern of results suggests that patients were more likely to use humor as a coping strategy than they were to express humor in the form of laughter. The two measures of humor were moderately correlated with each other in this sample ($r = .36$, $P < .02$).

Table 2 – Sense of humor, psychological functioning, quality of life, and health status in Study 1 (n = 46)

Measure	Mean (± SD)	Range
Sense of humor		
CHS*	19.3 (± 3.4)	11-24
SHRQ*	56.6 (± 9.2)	38-79
Psychological functioning		
CESD†	13.4 (± 8.4)	1-29
STAI†	36.9 (± 9.9)	20-57
Quality of life		
SF-36 mental composite score*	51.7 (± 10.3)	28-69
SF-36 physical composite score*	30.9 (± 10.9)	10-62
Health status		
ILLNESS-E†	.50 (± .76)	0-3
ILLNESS-D†	5.0 (± 9.0)	0-28

CHS, Coping Humor Scale; *SHRQ*, Situational Humor Response Questionnaire; *CESD*, Center for Epidemiological Studies—Depression Scale; *STAI*, State-Trait Anxiety Inventory, trait scale; *SF-36*, Medical Outcomes Study, 36-Item Short Form Health Survey; *ILLNESS-E*, number of infectious illnesses experienced in previous 4 weeks; *ILLNESS-D*, number of days sick with infectious illness in previous 4 weeks.

*Higher scores on these measures indicate more optimal functioning.

†Lower scores on these measures indicate more optimal functioning.

Consistent with previous studies of patients with COPD,[19,20] patients reported impaired psychological functioning, diminished quality of life, and recent infectious illness, as indicated by the means and ranges of scores in Table 2. Although the mean score on the CESD reflected normal emotional functioning (13.4 ± 8.4 out of a possible score of 60), 37% of the sample (n = 17) scored in the depressed range (≥16). Patients reported experiencing above-average anxiety in their daily lives (mean STAI = 36.9 ± 9.9 out of a possible score of 80), in comparison to age-matched norms.

Scores on the SF-36 revealed significant impairment in physical functioning. Although the Mental Health composite score (mean, 51.7 ± 10.3) was close to age-based norms (52.7), the Physical Functioning composite score (mean, 30.9 ± 10.9) was well below the age-based norm (43.3).

Patients experienced an average of .50 (± .76) episodes of infectious illness in the previous 4 weeks, with the number of episodes ranging from 0 to 3. Symptoms of infectious illness were experienced for a mean of 5.0 (± 9.0) days during the previous month, with 9% of patients experiencing symptoms for all 28 days.

Correlational analyses indicated that sense of humor was associated with enhanced psychological functioning, better quality of life, and fewer sick days. The CHS was inversely correlated with depression ($r = -.47$, $P < .001$) and anxiety ($r = -.51$, $P < .001$), and positively correlated with mental health aspects of quality of life ($r = .57$, $P < .001$). A moderate but

Table 3 – Correlation of sense of humor with psychological functioning, quality of life, and health status in Study 1 (n = 46)

	Sense of humor	
	CHS	SHRQ
Psychological functioning		
CESD	−.47‡	−.14
STAI	−.51‡	−.39†
Quality of life		
SF-36 physical composite score	.11	.02
SF-36 mental composite score	.57‡	.26*
Health status		
ILLNESS-E	−.20	.24
ILLNESS-D	−.34*	−.10

CHS, Coping Humor Scale; *SHRQ*, Situational Humor Response Questionnaire; *CESD*, Center for Epidemiological Studies—Depression Inventory; *STAI*, State-Trait Anxiety Inventory, trait scale; *SF-36*, Medical Outcomes Study, 36-Item Short Form Health Survey; *ILLNESS-E*, number of infectious illnesses experienced in previous 4 weeks; *ILLNESS-D*, number of days sick with infectious illness in previous 4 weeks.
*$P < .10$.
†$P < .01$.
‡$P < .001$.

nonsignificant relationship was evident between the CHS and number of days with an infectious illness ($r = -.34$, $P = .075$). The SHRQ exhibited a similar pattern of results, although the magnitude of correlations was smaller, as shown in Table 3.

Study 2

Pulmonary function in the sample was consistent with severe airway obstruction, as indicated by a mean FEV_1% of 45.6 (± 15.8) and a mean FEV_1/FVC of .52 (±.17). Patients were primarily in GOLD class[14] II or III (class I, 5%; class II, 41%; class III, 36%; and class IV, 18%). Patients randomized to the humor condition did not differ from patients randomized to the neutral condition with regard to demographic characteristics, baseline pulmonary function, mood state, or dyspnea, as shown in Table 4.

The induction of laughter was effective, as evidenced by 2 manipulation checks. First, the amount of laughter exhibited by each patient was timed in seconds by 2 independent raters who coded videotapes of each participant. Patients in the humor condition laughed significantly more than patients in the neutral condition during the presentation (195.4 ± 136.6 seconds vs. 1.0 ± 1.6 seconds of laughter, $P < .001$). Second, to assess whether the humor presentations had their intended effect of inducing mirth, each participant responded to the item, "How funny did you find the video presentation?" with response options ranging from 0 (not at all funny) to 5 (very funny). As expected, the humor presentations were rated as funnier than the neutral presentations (humor, 4.4 ± 1.0 vs. neutral, 1.3 ± .5; $P < .001$).

Repeated-measures ANOVA revealed a significant group × time interaction for FRC ($F[1,18] = 9.84$, $P < .01$, $\eta_p^2 = .35$), with FRC increasing significantly in the humor condition after the induction of laughter ($F[1,18] = 6.04$, $P = .03$, effect size $\eta^2 = .85$), but decreasing significantly in the neutral condition ($F[1,19] = 7.28$, $P = .02$, $\eta^2 = .47$; Figure 3).

Repeated-measures ANOVA revealed that the group × time interaction for RV was significant ($F[1,17] = 5.82$, $P < .03$, $\eta_p^2 = .25$). After the induction of laughter, RV was significantly higher among patients in the humor condition than among patients in the neutral condition (mean, 4.6 ± 1.6 L versus 3.1 ± 1.0 L, respectively; $P < .03$). Repeated-measures ANOVA revealed no effect for disease severity, as measured by FEV_1% predicted.

Regarding mood state, repeated-measures ANOVA revealed no group × time interaction for positive affect, but patients in the humor condition exhibited more positive affect after the induction of laughter than did patients in the neutral condition (humor, 38.7 ± 6.7 vs. neutral, 29.6 ± 7.1; $P < .01$). The induction of laughter had no effect on negative affect (PANAS-N) or dyspnea.

Laughter as a Predictor of Change in Pulmonary Function
Hierarchical regression analyses indicated that the amount of laughter exhibited during the video presentation did not predict changes in FRC or RV from baseline to recovery.

Disease Severity as a Predictor of Change in Pulmonary Function
An exploratory post hoc series of hierarchical regression analyses was performed to examine the extent to which severity of disease predicted change in pulmonary function after the induction of laughter. These analyses were performed to examine possible mechanisms underlying the increased air-trapping exhibited by patients in the humor condition. For each regression model, pulmonary function at recovery (FRC or RV) was the dependent variable, with baseline pulmonary function (FRC or RV) and severity of disease (FEV_1%) entered as the independent variables in steps 1 and 2, respectively. These analyses only included patients in the humor condition, and are thus considered preliminary because of the limited sample size (n = 12). Disease severity was not a significant predictor of change in FRC or RV after the induction of laughter.

Discussion

To the best of our knowledge, this was the first investigation to examine the influence of 2 facets of humor (sense of humor and laughter) on pulmonary function, psychological functioning, quality of life, and health status among patients with COPD. The pattern of findings in these 2 studies suggests that different facets

Table 4 – Pulmonary function, mood state, and dyspnea at baseline and recovery in Study 2 (n = 22)

Measure	Humor		Neutral	
	Baseline	Recovery	Baseline	Recovery
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Pulmonary function				
FEV_1%	42.4 (17.2)	40.6 (16.4)	49.4 (13.7)	48.2 (15.0)
FVC%	64.8 (19.3)	63.0 (20.1)	76.8 (23.8)	77.9 (23.6)
FEV_1/FVC	.52 (.20)	.50 (.16)	.52 (.14)	.50 (.15)
FRC (L)	4.9 (1.9)	5.8 (2.3)*	3.9 (1.0)	3.7 (1.1)*
RV (L)	3.9 (1.3)	4.6 (1.6)	3.3 (1.0)	3.1 (1.0)
Mood state				
PANAS-P	37.3 (6.3)	38.7 (6.7)	32.8 (7.2)	29.6 (7.1)
PANAS-N	11.0 (1.7)	10.4 (1.2)	11.7 (2.2)	10.8 (1.9)
Dyspnea				
NRS	2.0 (2.1)	2.6 (2.1)	2.3 (2.8)	2.6 (3.3)

FEV_1, Forced expiratory volume in 1 second; *FVC*, forced vital capacity; *FRC*, functional residual capacity; *L*, liters; *RV*, residual volume; *PANAS-P*, Positive and Negative Affectivity Scales, positive scale; *PANAS-N*, Positive and Negative Affectivity Scales, negative scale; *NRS*, Numeric Rating Scale.
Patients in the humor and neutral conditions did not differ with regard to demographics or baseline pulmonary function.
*$P < .05$, within-group comparison across time.

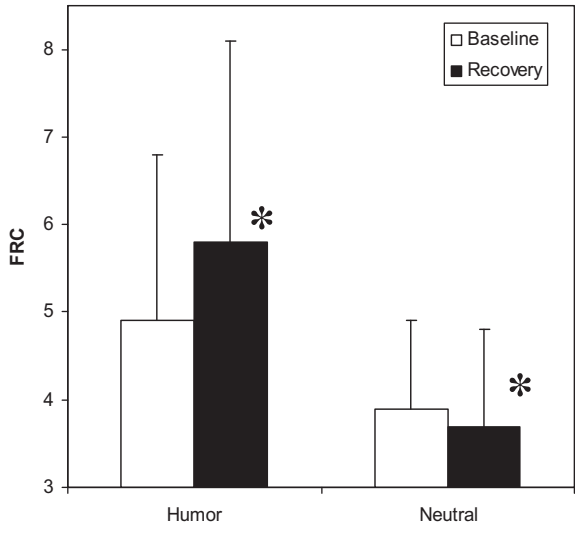

Figure 3 – Changes in functional residual capacity (FRC) after the induction of laughter. *$P < .05$, within-group change.

of humor exert varying effects on patients with COPD. Specifically, a sense of humor can be beneficial for individuals with COPD, but overt expressions of humor (e.g., laughter) may not be helpful.

The symptom profile of the study sample was typical of the COPD population, with elevated depressive symptoms, diminished quality of life, and increased incidence of infectious illness. The results of Study 1 indicate that sense of humor was associated with positive psychological functioning. Specifically, coping by means of humor was associated with lower levels of depression and anxiety and a greater quality of life. These results suggest a positive relationship between humor and enhanced psychological functioning among patients with COPD, as reported among healthy adults.[2,3]

With regard to health status, the results offer tentative support for the hypothesis that sense of humor may be associated with recent illness episodes. Although not statistically significant, a trend emerged indicating that sense of humor may be inversely associated with number of days during which symptoms of infectious illness persisted ($r = -.34$, $P = .075$). These findings should be interpreted with caution, and warrant further investigation. The Health Review is an indirect clinical indicator of physical health, but was associated with physicians' ratings of health as well as parameters of immune functioning among healthy adults.[34-36]

The findings of Study 1 must be interpreted with caution because of the correlational research design. Although previous research findings based on prospective data suggest that a sense of humor improves emotional functioning and health status over time,[6,40,41] the present study cannot confirm the direction of these relationships. Future work in this area should include assessments of pulmonary function to determine if these relationships are moderated by the severity of disease.

The course of COPD is progressive and irreversible in nature, but a sense of humor may offer protection from the negative psychosocial and health sequelae of the disease, including the risk of depressive symptoms, impairment in quality of life, and, perhaps, respiratory infections. Of the 2 measures used in Study 1 to assess sense of humor, the CHS was more strongly associated with psychological function and quality of life than was the SHRQ. This pattern of findings suggests that using humor to cope with stress is associated with better psychological functioning

among patients with COPD than is expressing humor outwardly in daily life.

The differential health effects of coping with humor (CHS) vs. expressing humor (SHRQ) were further validated by the results of Study 2. The induction of laughter failed to produce expected improvements in lung volumes. Instead, pulmonary changes indicated that laughter had acutely negative effects on lung volumes among patients with COPD, as demonstrated by increased hyperinflation and air-trapping after laughter. The FRC increased by 15% among patients in the humor condition, but decreased by 5% among patients in the neutral condition. A similar trend emerged for RV, with patients in the humor condition exhibiting a 16% increase across time, and patients in the neutral condition exhibiting a decrease of 6%. The observed differences in conditions were not attributable to baseline differences in severity of disease or pulmonary functioning.

The results of this study contradict Fry's assertion that RV decreases during laughter as a result of the predominantly expiratory nature of the behavior.[5,11] Findings from the present investigation suggest that pathophysiologic changes in the lungs associated with COPD result in an acute deterioration of lung function after laughter. One explanation for this finding is that laughter may be associated with an increase in respiratory rate, which in turn may trigger dynamic hyperinflation in patients with COPD.[42] Moreover, laughter may trigger bronchial hyperresponsiveness and increased obstruction, comparable to the laughter-induced and exercise-induced attacks reported by patients with asthma.[43] Future studies incorporating healthy control subjects and pulmonary comparison groups (e.g., patients with asthma) will further document the contributions of COPD to the present pattern of findings.

In contrast to our findings, Brutsche et al reported modest decreases in lung hyperinflation among patients with COPD who observed a live performance by a clown.[15] However, the pulmonary improvements documented in that study were associated with smiling. They also found that intense laughter led to increased hyperinflation. Thus, those data also suggest that less overt expressions of humor may be more favorable than overt laughter in patients with COPD. The present investigation was limited insofar as it addressed only the acute effects of laughter. The duration of pulmonary changes that occur immediately after laughter is unknown, as are any potential cumulative effects of laughter. Brutsche et al found that the pulmonary changes associated with a clown's performance were no longer present 2 hours later,[15] suggesting that laughter-induced pulmonary changes may be short-lived. Furthermore, whether this pattern of results is unique to laughter, or perhaps reflects the consequences of emotional arousal, is unclear. Although all patients refrained from using pulmonary inhalers for 60 minutes before participating in the study, this study was also limited because it contains no information about bronchodilator use more than 60 minutes before study participation. In the future, tighter control should be exercised over the timing and use of bronchodilators in relation to the administration of an intervention. Future research in this area could also be strengthened by making provisions to ensure that research personnel are blinded to patient group assignment, which was not possible in this preliminary investigation.

Overall, the findings of this investigation confirm the importance of personality characteristics such as sense of humor in the psychological health of patients with COPD. The tendency to use a sense of humor may offer protection from some of the negative psychosocial sequelae of COPD. Brief assessments of coping by means of humor may offer a relatively easy method to identify patients potentially at risk of emotional distress. Despite the positive association of sense of humor with psychological functioning, quality of life, and health status, the overt expression of humor (e.g., laughter) may be an irritant, at least for some patients with COPD, contributing to poorer pulmonary functioning via acute increases in FRC.

The pattern of findings in these 2 studies underscores the notion that humor is multifaceted, and that measuring one aspect of humor may be insufficient to evaluate the complex relationship of humor with psychological and physiological functioning. Future research should continue to examine the multiple facets of humor for a better understanding of the complex relationship between humor and health. For patients with COPD, the appreciation and use of humor appear more beneficial than do overt expressions of humor. The identification of techniques to maintain or increase a sense of humor may provide a positive supplement to standard pulmonary care for patients with COPD, with the goal of increasing psychological functioning, quality of life, and health status. Ultimately, a future challenge for the behavioral management of patients with COPD may be to identify strategies for increasing a sense of humor without promoting laughter.

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