



Depressed mood predicts pulmonary rehabilitation completion among women, but not men

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Received 13 February 2014; accepted 14 April 2014

Available online 26 April 2014

KEYWORDS

Depression;
COPD;
Pulmonary
rehabilitation

Summary

Background: As many as 30% of patients who start pulmonary rehabilitation (PR) fail to complete it, and depressed mood has been associated with PR non-completion. Depression is more common in women than men with COPD and historically women with COPD have been under studied. However, no studies to date have investigated gender-specific predictors of PR completion.

Methods: The study included 111 patients with COPD who enrolled in a community based outpatient PR program in Providence, RI. Patients who attended 20 or more sessions were designated “completers”. Depression was measured using the CES-D. Logistic regression models were evaluated to test depressed mood as a predictor of PR completion. Analyses controlled for demographic and health variables found to differ between completers and non-completers.

Results: Patients were 95% white and 49.5% women, and 74% had a GOLD stage ≥ 3 . Sixty-eight percent of patients were PR completers. A logistic regression model, showed that lower depressed mood independently predicted PR completion across all patients (adjusted OR = 0.92, $p = .002$). In gender-stratified analyses, lower depressed mood was an independent predictor of PR completion for women (adjusted OR = .91, $p = .024$) but not men (adjusted OR = .97, $p = .45$). Greater 6-min walk test distance was also an independent

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predictor of PR completion among women.

Conclusion: Depressed mood is an important predictor of completion of community based PR among women. Screening and brief treatment of depression should be considered in practice.
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Chronic obstructive pulmonary disease (COPD) is a common and often disabling inflammatory lung disease characterized by progressive airway obstruction that is not fully reversible [1,2]. An important component of non-pharmacologic treatment for COPD is multidisciplinary pulmonary rehabilitation (PR), which improves exercise tolerance, perceived dyspnea, depression and anxiety, and health-related quality of life [2–5]. The minimum recommended duration for PR is six weeks [2], with longer programs being more effective [6,7]. However, as many as 30% of patients who begin PR programs drop out prematurely [8–11].

Several studies have identified baseline variables that predict PR non-completion [11], including depressed mood. Depressive symptoms and Major Depressive Disorder are common among patients with COPD [12,13], and have been associated with increased mortality, greater symptom burden and increased hospitalization, decreased functioning, and diminished quality of life [13–19]. High rates of depression among those with COPD appear to be at least partially caused by the activity limitations due to COPD [20], which is similar to findings in other chronic illnesses [21]. It is well-established that women in the general population experience higher rates of depression relative to men, and this gender difference has also been observed among those with COPD [13,22,23]. Women may also be more likely to become depressed after a COPD diagnosis and greater duration of COPD increases the risk of developing depression in women but not men [13].

Women have historically been woefully underrepresented in COPD research [24]. To our knowledge, no studies have evaluated predictors of PR completion separately for male and female PR attendees. Further, the only data on predictors of PR completion from US based samples have included a disproportionate percentage of men (61–96%) [25,26]. Therefore, the current study was designed to investigate gender specific predictors of completion of a comprehensive US community-based PR program, with a focus on investigating depressed mood. We hypothesized that depressed mood will be an independent predictor of PR completion in both genders after controlling for relevant covariates.

Method

This sample was drawn from patients attending a comprehensive outpatient PR program in Providence, RI. The PR treatment team includes an exercise physiologist, respiratory therapist, physical therapist, clinical psychologist, and MD pulmonologist. The PR program includes assessment, treatment, and education for patients with COPD and other respiratory disorders. The clinical psychologist (MLB) conducted an in person evaluation with PR patients at intake. If

patients reported significant illness adjustment issues, stress, depressed mood, or anxiety, they were offered brief psychotherapy. In general psychotherapy focused on pulmonary specific adjustment issues, such as a) accepting functional limitations, b) adherence to medications and oxygen use, c) pacing of activities and prioritizing most important activities, and d) not judging self-worth based on the quantity of tasks performed. Cognitive behavioral interventions were provided as needed to treat depression and anxiety symptoms.

Patients are expected to attend this PR program twice a week for 20–36 total sessions. Because the number of PR sessions pre-approved by local insurance providers ranged from 20 to 36 sessions and because at the time of data collection Medicare capped PR attendance at 36 *lifetime* sessions, it was program policy to consider planned discharge after 20 sessions (in the case of Medicare coverage, so that patients could save some lifetime sessions for future exacerbations). These planned discharge decisions also incorporated patient progress (especially progress towards patient functional goals) and ability to exercise independently following discharge. All patients in our sample described below were pre-approved by their public or private insurance company at PR intake for at least 20 sessions. Therefore, for the current study, patients who attended 20 or more sessions were designated as *completers* and those who attended fewer than 20 sessions as *non-completers*.

Participants

Data were obtained by combining an existing quality improvement database (which included all standardized intake measures listed below) and a retrospective chart review (to confirm diagnostic/co-morbidity status and collect demographic and attendance data) of patients enrolled in the PR program. All patients meeting formal COPD criteria (i.e., $FEV_1/FVC < 0.7$) and enrolled in the program between October 2007 and February 2012 were reviewed for inclusion.

We first identified patients that would likely have a diagnosis of COPD (i.e., those with a ICD-9 diagnostic code indicating a chronic airway obstruction) and who had valid scores on all of our primary standardized measures (i.e., complete data at intake on the CES-D, all 4 subscales of the Chronic Respiratory Questionnaire (CRQ) [27] the 6-min walk test, and an FEV-1 test) in the existing quality improvement database. This produced 146 patients whose charts were selected for review. Of these 146 patients, medical charts from 17 were unavailable for review. A total of 129 charts were reviewed. Of these 129 patients, medical charts indicated that 18 patients had a FEV_1/FVC ratio >0.7 , indicating they did not meet formal criteria for COPD

at PR intake. Thus, we report on a sample of 111 patients with COPD who started at PR.

Measures

All demographics, smoking history and oxygen use were obtained through patient self-report at intake. Travel distance was calculated by determining the distance from the patient's home address to the PR clinic using a web based mapping tool. BMI was calculated using the height and weight measured by staff.

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria was used for the diagnosis and severity of COPD for the current study. Spirometry values—forced expiratory volume 1s (FEV₁) and forced vital capacity (FVC) post-bronchodilators—were obtained and evaluated against the cutoff for diagnosis (FEV₁/FVC < 0.70). Severity is classified into four "GOLD stages". Gold I is mild (FEV₁ ≥ 80% predicted), Gold II is moderate (50% ≤ FEV₁ < 80% predicted), Gold III is severe (30% ≤ FEV₁ < 50% predicted) and Gold IV is very severe (FEV₁ < 30% predicted).

Patients completed the Chronic Respiratory Questionnaire (CRQ) [27] to assess disease-related quality of life. The CRQ comprises four core domains, three of which use standardized items rated on a Likert scale—fatigue (4-items), emotional functioning (7-items), and mastery (4-items). The fourth domain—dyspnea (5-items)—is based on self-report of shortness of breath while performing personally relevant activities. Higher scores on CRQ domains indicate *better* functioning, and a 0.5 change in domain score is considered clinically significant [28].

Exercise tolerance was measured by the 6-min walk test (SMWT) [29] in general accordance with the guidelines of American Thoracic Society. We modified the SMWT by having test administrators walk with patients as they completed the test and, with patients enrolled before 2010, they carried oxygen tanks for the patient. Number of feet walked (NFW) was used for the current analysis.

The Center for Epidemiologic Studies Depression Scale (CES-D) [30] was used to measure depressed mood. This 20-item measure assesses depressive symptoms over the past week. Scores range from 0 to 60, with scores ≥16 suggestive of a major depressive disorder [30].

Analytic plan

Summary statistics (frequencies, means and standard deviations) were used to describe the sample characteristics, health indicators, pulmonary function, and psychosocial variables by PR completion and gender. Differences between completers and non-completers were examined using a series of bivariate analyses (chi-square, Fisher's exact test, or one-way analysis of variance), stratified by gender. Demographic and health variables that were significantly different between men and women completers and non-completers were included in subsequent analyses. Logistic regression models, conducted separately for the overall sample and by men and women, were evaluated to test our hypothesis that depressed mood predicts PR

program completion. All data analyses were conducted using Stata 12 [31].

Results

Characteristics of the overall sample

Patients ($N = 111$; 95% White) were men ($n = 56$) and women ($n = 55$) between 34 and 89 years of age (median = 70) enrolled in an outpatient PR program. Less than half of the patients reported any post-secondary education (44%); few were currently employed (15%). Many patients were married (53%; 30% widowed, 13% divorced, 5% never married) and/or cohabitating (54% with a partner and 18% with another individual). Patients lived an average of 11 miles (SD = 13) from the outpatient PR program site.

Most patients were former smokers (95%); few patients reported never smoking (5%). Former smokers smoked an average of 41 years (SD = 12) and had quit for a median of 7 years (ranging from less than 1 year to 55 years). Less than half of the patients (48%) required home oxygen use. Most patients were overweight or obese (66%) with an average body mass index (BMI) of 29 (range = 16–55). Patients reported a number of medical co-morbidities including orthopedic (41%), heart disease (25%), diabetes (17%), asthma (12%), cancer (7% lung; 9% other cancers), and neurological conditions (8%). Half of the patients (51%) were classified as having severe COPD (GOLD Stage III); 23% with very severe COPD (GOLD Stage IV) and 23% with moderate COPD (GOLD Stage II). Patients walked a median of 816 feet in the SMWT (range = 135–1567).

Pulmonary rehabilitation program completion

Of the 111 patients included in the study, 68% ($n = 75$; 39 men and 36 women) completed at least 20 sessions (i.e., *completers*). Patients who did not complete 20 sessions (32%; i.e., *non-completers*), attended, on average, 11 sessions (range = 1–19). There were no differences between completers and non-completers on any demographic variable at intake (data not shown). Completers differed from non-completers with respect to co-morbidities and psychosocial functioning at intake. Compared with non-completers, completers were less likely to be diabetic ($\chi^2 [1] = 4.27, p = .039$), were higher in CRQ-emotional functioning ($F [1, 109] = 6.25, p = .014$), and reported fewer depressive symptoms ($F [1, 109] = 12.36, p < .001$). A logistic regression model, controlling for diabetes,¹ showed that depressed mood was a significant predictor of PR program completion, adjusted OR = 0.92 (95% CI = 0.88, 0.97), $p = .002$. Diabetes status continued to predict a lower likelihood of completion in the multivariate model adjusted OR = .31 (95% CI = 0.11, 0.90), $p = .03$.

¹ We did not control for CRQ-emotional functioning in the overall model because there is significant content and conceptual overlap between this sub-scale and depression symptoms measured by the CESD ($r = 0.67, p < .001$).

Pulmonary rehabilitation program completion stratified by men and women

Data for the patients stratified by PR completion and gender are reported in Table 1. There were no within gender differences between completers and non-completers on any demographic variable (see Table 1).

There were no differences between completers and non-completers on health indicators; completers and non-completers differed on co-morbidities, pulmonary function, and depressed mood (see Table 1). Among women, completers were less likely to be diabetic ($p = .041$, two-tailed Fisher's exact test), performed better on the 6-min walk distance ($F [1, 54] = 5.13, p = .028$), and had

Table 1 Characteristics of men and women by pulmonary rehabilitation program completion.

	Men		Women	
	Completers (<i>n</i> = 39)	Non-completers (<i>n</i> = 17)	Completers (<i>n</i> = 36)	Non-completers (<i>n</i> = 19)
Demographics				
Age, <i>M</i> years (SD)	70 (10)	70 (14)	70 (9)	67 (13)
Caucasian, <i>n</i> (%)	37 (95)	16 (94)	36 (100)	17 (89)
Married, <i>n</i> (%)	26 (70)	13 (81)	12 (34)	4 (25)
Cohabitation, <i>n</i> (%)	32 (82)	14 (82)	22 (61)	11 (61)
College education, <i>n</i> (%)	17 (46)	8 (53)	14 (42)	6 (35)
Employed, <i>n</i> (%)	7 (18)	3 (18)	5 (14)	2 (11)
Travel distance, <i>M</i> miles (SD)	12 (7)	9 (4)	8 (5)	8 (5)
Health indicators				
Smoking status				
Never smoker, <i>n</i> (%)	1 (3)	0 (0)	3 (8)	1 (5)
Former Smoker, <i>n</i> (%)	38 (97)	17 (100)	33 (92)	18 (95)
Smoking duration, <i>M</i> years (SD)	40 (14)	42 (10)	40 (10)	42 (12)
Smoking cessation, <i>M</i> years (SD)	13 (14)	11 (14)	10 (9)	7 (7)
Home oxygen use, <i>n</i> (%)	18 (47)	7 (41)	18 (50)	10 (53)
Body mass index, <i>M</i> (SD)	27 (6)	30 (5)	29 (8)	29 (9)
Co-morbid pulmonary conditions, <i>n</i> (%)				
Asthma	3 (8)	4 (24)	4 (11)	2 (11)
Sleep apnea	1 (3)	1 (6)	1 (3)	0 (0)
Pulmonary hypertension	1 (3)	1 (6)	0 (0)	0 (0)
Lung cancer	4 (10)	0 (0)	3 (8)	1 (5)
Other pulmonary	2 (5)	0 (0)	2 (6)	1 (5)
Other co-morbid conditions, <i>n</i> (%)				
Diabetes ^b	7 (18)	5 (29)	2 (6)	5 (26)
Heart disease	13 (33)	9 (53)	2 (6)	4 (21)
Neurological	2 (5)	2 (12)	4 (11)	1 (5)
Orthopedic	14 (36)	9 (53)	16 (44)	6 (32)
Cancer (not including lung)	5 (13)	1 (6)	3 (8)	1 (5)
Other major	1 (3)	0 (0)	2 (6)	1 (5)
Total no. of co-morbid conditions, <i>M</i> (SD)	1 (<1)	2 (<1)	<1(<1)	<1(1)
Pulmonary function				
GOLD stage, <i>n</i> (%)				
I	1 (3)	0 (0)	1 (3)	0 (0)
II	6 (15)	3 (18)	11 (31)	6 (32)
III	21 (54)	12 (71)	15 (42)	9 (47)
IV	11 (28)	2 (12)	9 (25)	4 (21)
FEV ₁ , <i>M</i> (SD)	0.40 (0.17)	0.41 (0.12)	0.44 (0.15)	0.41 (0.14)
6-min walk distance <i>M</i> (SD) ^b	850 (322)	875 (414)	851 (384)	629 (256)
Chronic respiratory questionnaire <i>M</i> (SD)^c				
Dyspnea	3.30 (1.17)	2.93 (1.24)	2.97 (1.09)	2.72 (1.11)
Fatigue ^a	4.06 (1.03)	3.25 (1.18)	3.64 (1.24)	3.61 (1.21)
Emotional Functioning	5.02 (1.13)	4.34 (1.52)	4.87 (1.20)	4.32 (1.20)
Mastery	4.82 (1.33)	4.37 (1.56)	4.68 (1.35)	4.20 (1.31)
Depression (CES-D) <i>M</i> (SD) ^{a,b}	11.67 (7.33)	17.47 (11.67)	11.17 (7.20)	17.84 (11.34)

^a Indicates significant completer vs. non-completer differences among men ($p \leq .05$).

^b Indicates significant completer vs. non-completer differences among women ($p \leq .05$).

^c Higher scores on Chronic Respiratory Questionnaire domains indicate better functioning.

lower depressed mood ($F [1, 54] = 7.11, p = .01$) than non-completers. For men, only the CRQ-fatigue and depressed mood differed with completers reporting significantly less fatigue ($F [1, 55] = 6.70, p = .012$) and fewer depressive symptoms ($F [1, 55] = 5.10, p = .028$) than non-completers.

Two separate logistic regression models, stratified by gender, were conducted to evaluate whether depressed mood was a significant independent predictor of PR program completion. The first model, controlling for diabetes and 6-minute walk distance, showed that depressed mood was a significant independent predictor of PR program completion for women, adjusted OR = 0.91 (95% CI = 0.84, 0.99), $p = .024$ (see Fig. 1). Six-minute walk distance remained a significant predictor in this model (adjusted OR = 1.00, 95% CI = 1.0003, 1.0037, $p = .02$), but diabetes status did not (adjusted OR = 0.18, 95% CI = 0.03, 1.25, $p = .08$).

A second model, controlling for CRQ-fatigue, showed that depressed mood was not significantly related to PR program completion for men, adjusted OR = 0.97 (95% CI = 0.89, 1.05), $p = .45$ (see Fig. 1). CRQ-Fatigue was also non-significant in this model (adjusted OR = 1.66, 95% CI = 0.86, 3.20, $p = .13$).

To explore the differential effect of CRQ-fatigue in men and women, in a post hoc analysis we compared the correlation between depressed mood and CRQ-fatigue between men and women. Depressed mood was significantly more correlated with CRQ-fatigue in men ($r = -.62$) than in women ($r = -.32$; $Z = -2.02, p = .04$).

Discussion

A significant minority of patients (32%) were non-completers, which is consistent with previously reported rates of PR non-completion. When all patients were included in the analyses, depressed mood was found to be a strong predictor of PR completion in both bivariate and multivariate analyses, which is consistent with prior research [11]. However, differences emerged when men and women were analyzed separately; in multivariate analyses depressed mood was a significant predictor of

completion of PR among women, but not among men. We also identified exercise capacity (6-min walk test distance) as an independent predictor of PR completion in women. Finally, in a post-hoc analysis we found that depressed mood was significantly more correlated with fatigue in men than in women.

Results clearly indicate that depressed mood is an important predictor of completion of community based PR among women. Given these and previous findings, depression should be assessed at intake and considered a risk factor for non-completion among women. It is tempting to conclude from these results that depression is not particularly important for community based PR completion among men with COPD, but this interpretation is complicated by the fact that fatigue (which was controlled for in multivariate analyses among men) is a symptom of both COPD and major depressive disorder. In fact, two items on the CES-D directly assess fatigue: "I felt that everything I did was an effort" and "I could not get going". Thus, fatigue measured on the CRQ may be a symptom of depression, COPD, or both conditions. Although the relationship between fatigue and depression in COPD patients has not been extensively studied, there are data suggesting that men are more likely to express somatic complaints (such as fatigue) [32] rather than emotional concerns. Further, there is evidence that relationships between fatigue and emotions differ by gender in heart failure patients [33]. Our post-hoc analysis showing a higher correlation between depressed mood and fatigue in men than in women suggests that similar differences may exist among COPD patients. Further, there is some evidence that depression is particularly linked to early mortality in men with COPD. In a large sample ($n > 35,000$) of primary care patients with COPD in the UK, Schneider et al. [13] found that depression was strongly predictive of 1 year mortality in men, but not in women. Thus, the current findings should not be used to dismiss the importance of depression symptoms among men with COPD.

It is notable that patients in the current sample had access to on-site assessment and brief psychotherapy from a clinical psychologist. Thus, more intensive depression treatment or more targeted functional support for attendance might be needed to address depressive symptoms and prevent PR non-completion. There is limited prior work on treatment of depression in patients with COPD, but there is some evidence to support the effectiveness cognitive-behavioral psychotherapies for improving depression in this population [34]. Depression treatments that require patients to attend additional appointments at separate locations are likely unfeasible for patients already struggling with regular PR attendance. Further, many barriers to PR attendance and completion are logistical (e.g., routine disruption, transportation, lack of support [11]), thus any psychotherapy intervention targeting PR attendance should target mood and include active, practical problem-solving of logistical barriers. Behavioral Activation and Problem-solving Therapy are two cognitive-behavioral treatment packages that 1) focus on practical problem-solving, 2) have been effective for treating depression in other chronically ill populations, and 3) have been successfully integrated into medical treatment settings [35,36]. These treatments may be particularly fitting to

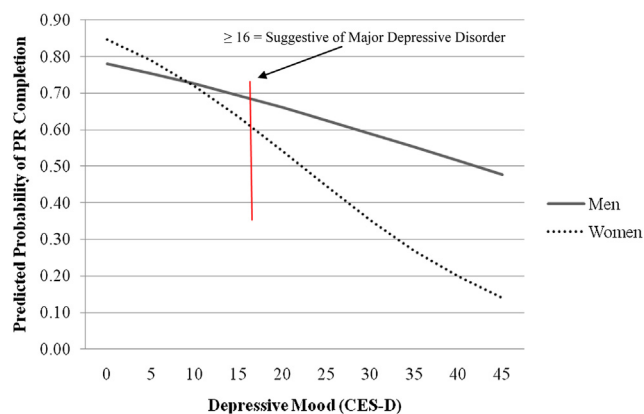


Figure 1 Predicted probability of completing the PR program by depressive symptomatology. Note. Analyses controlled for gender specific predictors of completion indicated in Table 1.

simultaneously target PR completion and improved mood, and there is also evidence that these treatments can be provided remotely (e.g. [37]), minimizing the need for patients travel to extra sessions.

Results also suggest that higher exercise capacity may be a gender specific predictor of PR completion. It may be the case that the exercise components or PR are more physically aversive or more anxiety producing for women when their exercise capacity is low. Why low exercise capacity is predictive of non-completion in women but not men in this sample is unknown. It is possible that women who came of age before Title IX was passed in 1972 are less comfortable exercising in a public setting than men of the same generation. One previous study suggests exercise capacity measured by walk distance is predictive of PR completion [8], while two other studies found that it was not [38,39], but none of these studies reported gender specific results.

Several variables found to predict PR completion in previous studies, including living alone, body composition, travel distance, dyspnea, and oxygen use [8,38,40], were not predictive of completion in the current study. In addition, current smoking, which has been linked to PR non-completion in several samples, was not relevant to the current sample because it only included former and never smokers. Current smokers rarely attended this PR program because Medicare guidelines in this area at the time of data collection required that a patient have quit smoking at least 3 months prior to enrollment.

To our knowledge, this is the first study of predictors of PR completion 1) using a sample drawn from a community-based PR program in the US and 2) examining gender specific predictors of PR completion. Limitations of this study include 1) a smaller, mostly Caucasian sample, 2) a carefully defined and ecologically valid but nonetheless dichotomized outcome variable, 3) lack of a clinical interview to determine psychiatric diagnostic status, and 4) lack of information on patient utilization of psychiatric interventions as part of the PR program and concurrent psychiatric treatments outside of the PR program.

Conclusions

Depressive symptoms and Major Depressive Disorder are common among patients with COPD and predict future morbidity and mortality. Depressed mood predicts non-completion of PR, especially among women. These results and others [11] suggest that non-adherence to pulmonary rehabilitation may be one pathway through which depressed mood impacts COPD morbidity and mortality. Screening and brief treatment of depression should be considered in practice, and continued research on the interaction between gender, depression, and adherence with PR among those with COPD is warranted.

Conflict of interest statement

None of the authors have any personal or financial conflicts of interest relevant to this manuscript. NHLBI had no role in 1) the study design, 2) the collection, analysis and interpretation of data, 3) the writing of the manuscript, or 4) the decision to submit the manuscript for publication.

Acknowledgment

The effort of A. Busch on this project was supported by K23HL107391 from the National Heart, Lung, and Blood Institute. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Heart, Lung, and Blood Institute or the National Institutes of Health.

References

- [1] Celli BR, MacNee W. Standards for the diagnosis and treatment of patients with COPD: a summary of the ATS/ERS position paper. *Eur Respir J* 2004;23:932–46.
- [2] Vestbo J, Hurd SS, Agusti AG, et al. Global strategy for the diagnosis, management, and prevention of COPD. GOLD executive summary. *Am J Respir Crit Care Med* 2013;184:347–65.
- [3] Nici L, Donner C, Wouters E, et al. American Thoracic Society/European Respiratory Society statement on pulmonary rehabilitation. *Am J Respir Crit Care Med* 2006;173:1390–413.
- [4] Lacasse Y, Martin S, Lasserson TJ, Goldstein RS. Meta-analysis of respiratory rehabilitation in chronic obstructive pulmonary disease: a Cochrane systematic review. *Eur Medicophys* 2007;43:475–85.
- [5] Coventry PA, Hind D. Comprehensive pulmonary rehabilitation for anxiety and depression in adults with chronic obstructive pulmonary disease: systematic review and meta-analysis. *J Psychosom Res* 2007;63:551–65.
- [6] Green RH, Singh SJ, Williams J, Morgan MDL. A randomised controlled trial of four weeks versus seven weeks of pulmonary rehabilitation in chronic obstructive pulmonary disease. *Thorax* 2001;56:143–5.
- [7] Rossi G, Florini F, Romagnoli M, et al. Length and clinical effectiveness of pulmonary rehabilitation in outpatients with chronic airway obstruction. *CHEST* 2005;127:105–9.
- [8] Hayton C, Clark A, Olive S, et al. Barriers to pulmonary rehabilitation: characteristics that predict patient attendance and adherence. *Respir Med* 2013;107:401–7.
- [9] Keating A, Lee AL, Holland AE. Lack of perceived benefit and inadequate transport influence uptake and completion of pulmonary rehabilitation in people with chronic obstructive pulmonary disease: a qualitative study. *J Physiother* 2011;57:183–90.
- [10] Jones SE, Green SA, Clark AL, et al. Pulmonary rehabilitation following hospitalisation for acute exacerbation of COPD: referrals, uptake and adherence. *Thorax* 2013;69:181–2.
- [11] Keating A, Lee A, Holland AE. What prevents people with chronic obstructive pulmonary disease from attending pulmonary rehabilitation? A systematic review. *Chronic Respir Dis* 2011;8:89–99.
- [12] Schane RE, Walter LC, Dinno A, Covinsky KE, Woodruff PG. Prevalence and risk factors for depressive symptoms in persons with chronic obstructive pulmonary disease. *J Gen Intern Med* 2008;23:1757–62.
- [13] Schneider C, Jick SS, Bothner U, Meier CR. COPD and the risk of depression. *Chest* 2010;137:341–7.
- [14] Jennings JH, DiGiovine B, Obeid D, Frank C. The association between depressive symptoms and acute exacerbations of COPD. *Lung* 2009;187:128–35.
- [15] Ng TP, Niti M, Tan WC, Cao Z, Ong KC, Eng P. Depressive symptoms and chronic obstructive pulmonary disease: effect on mortality, hospital readmission, symptom burden, functional status, and quality of life. *Arch Intern Med* 2007;167:60–7.

- [16] Omachi TA, Katz PP, Yelin EH, et al. Depression and health-related quality of life in chronic obstructive pulmonary disease. *Am J Med* 2009;122: 778.e779-715.
- [17] Putman-Casdorph H, McCrone S. Chronic obstructive pulmonary disease, anxiety, and depression: state of the science. *Heart Lung: J Crit Care* 2009;38:34–47.
- [18] Xu W, Collet J-P, Shapiro S, et al. Independent effect of depression and anxiety on chronic obstructive pulmonary disease exacerbations and hospitalizations. *Am J Respir Crit Care Med* 2008;178:913–20.
- [19] de Voogd JN, Wempe JB, Koeter GH, et al. Depressive symptoms as predictors of mortality in patients with COPD. *Chest* 2009;135:619–25.
- [20] Katz PP, Julian LJ, Omachi TA, et al. The impact of disability on depression among individuals with COPD. *Chest* 2010;137: 838–45.
- [21] Mausbach BT, Chattillion EA, Moore RC, Roepke SK, Depp CA, Roesch S. Activity restriction and depression in medical patients and their caregivers: a meta-analysis. *Clin Psychol Rev* 2011;31:900–8.
- [22] Chavannes NH, Huibers MJH, Schermer TRJ, et al. Associations of depressive symptoms with gender, body mass index and dyspnea in primary care COPD patients. *Fam Pract* 2005;22:604–7.
- [23] Di Marco F, Verga M, Reggente M, et al. Anxiety and depression in COPD patients: the roles of gender and disease severity. *Respir Med* 2006;100:1767–74.
- [24] Lacasse Y, Wong E. Meta-analysis of respiratory rehabilitation in chronic obstructive pulmonary disease. *Lancet* 1996;348:1115.
- [25] Fan VS, Giardino ND, Blough DK, Kaplan RM, Ramsey SD. Costs of pulmonary rehabilitation and predictors of adherence in the National Emphysema Treatment Trial. *COPD: J Chronic Obstr Pulm Dis* 2008;5:105–16.
- [26] Steele BG, Belza B, Cain K, et al. The impact of chronic obstructive pulmonary disease exacerbation on pulmonary rehabilitation participation and functional outcomes. *J Cardiopulm Rehabil Prev* 2010;30:53–60.
- [27] Williams JE, Singh SJ, Sewell L, Guyatt GH, Morgan MD. Development of a self-reported Chronic Respiratory Questionnaire (CRQ-SR). *Thorax* 2001;56:954–9.
- [28] Williams JEA, Singh SJ, Sewell L, Morgan MDL. Health status measurement: sensitivity of the self-reported Chronic Respiratory Questionnaire (CRQ-SR) in pulmonary rehabilitation. *Thorax* 2003;58:515–8.
- [29] ATS statement: guidelines for the six-minute walk test. *Am J Respir Crit Care Med* 2002;166:111–7.
- [30] Radloff LS. The CES-D scale a self-report depression scale for research in the general population. *Appl Psychol Meas* 1977;1: 385–401.
- [31] StataCorp Stata statistical software: release 12. College Station, TX: StataCorp LP; 2011.
- [32] Strosahl KD. Training behavioral health and primary care providers for integrated care: a core competencies approach. In: O'Donohue WT, Byrd MR, Cummings NA, Henderson DA, editors. *Behavioral integrative care: treatments that work in the primary care setting*. New York: Brunner-Routledge; 2005. pp. 15–52.
- [33] Ekman I, Ehrenberg A. Fatigue in chronic heart failure – does gender make a difference? *Eur J Cardiovasc Nurs* 2002;1: 77–82.
- [34] Fritzsche A, Clamor A, von Leupoldt A. Effects of medical and psychological treatment of depression in patients with COPD—a review. *Respir Med* 2011;105:1422–33.
- [35] Hopko DR, Funderburk JS, Shorey RC, et al. Behavioral activation and problem-solving therapy for depressed breast cancer patients: preliminary support for decreased suicidal ideation [English] *Behav Modif* 2013;37:747–67.
- [36] Davidson KW, Rieckmann N, Clemow L, et al. Enhanced depression care for patients with acute coronary syndrome and persistent depressive symptoms: coronary psychosocial evaluation studies randomized controlled trial [English] *Arch Intern Med (1960)* 2010;170:600–8.
- [37] O'Mahen HA, Woodford J, McGinley J, et al. Internet-based behavioral activation—treatment for postnatal depression (Netmums): a randomized controlled trial [English] *J Affect Disord* 2013;150:814–22.
- [38] Fischer MJ, Scharloo M, Abbink JJ, et al. Drop-out and attendance in pulmonary rehabilitation: the role of clinical and psychosocial variables. *Respir Med* 2009;103:1564–71.
- [39] Selzler A-M, Simmonds L, Rodgers WM, Wong EYL, Stickland MK. Pulmonary rehabilitation in chronic obstructive pulmonary disease: predictors of program completion and success. *COPD* 2012;9:538–45.
- [40] Sabit R, Griffiths TL, Watkins AJ, et al. Predictors of poor attendance at an outpatient pulmonary rehabilitation programme. *Respir Med* 2008;102:819–24.