Journal of Clinical Psychology in Medical Settings (2022) 29:310–317
https://doi.org/10.1007/s10880-021-09828-7

Affective Comorbidity Associated with Symptoms, Lung Function, and Differences Between Patients with COPD for Biomass and Tobacco Smoke Exposure

Andrea Hernández-Pérez[1,2] · Inés Vargas-Núñez[2] · Bernardo Moreno-Jiménez[3] · Rogelio Pérez-Padilla[1,2] · Alejandra Ramírez-Venegas[1]

Accepted: 26 September 2021 / Published online: 7 October 2021
© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2021

Abstract
Anxiety and depression are common entities in patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD). This study aimed to determine the prevalence of affective comorbidity (depression and anxiety) associated with lung function, functional capacity, dyspnea, and quality of life; as well as the differences between groups of patients diagnosed with COPD associated with biomass (COPD-BE) and patients with COPD secondary to tobacco (COPD-TS). Comparative cross-sectional observational study. Multiple hierarchical regression models, analysis of variance, and covariance were carried out. A total of 291 COPD patients were evaluated, symptoms of depression were found to be higher in patients with COPD-BE than in patients with COPD-TS (5.3 ± 4.2 versus 4.2 ± 4, 1, $p = 0.016$), as well as anxiety complications (4.1 ± 3.8 versus 3.8 ± 3.3, $p = 0.095$), although with anxiety it was not statistically significant, being adjusted for age and FEV1. Patients with COPD-BE had higher prevalence of depression, compared to COPD-TS (41.2% versus 27.7%, $p = 0.028$). In the multivariate regression models, the variables of dyspnea and quality of life were associated with depression and anxiety, explaining 25% and 24% of the variability, respectively. Depression is higher in COPD-BE patients compared to COPD-TE patients, it is necessary to consider affective comorbidity in routine evaluation and provide a comprehensive intervention to prevent the effects on other clinical conditions of the disease.

Keywords Depression · Anxiety · Comorbidity · Chronic obstructive pulmonary disease

Introduction

Currently, 64 million persons suffer from Chronic Obstructive Pulmonary Disease (COPD) and 3 million individuals die from it each year. It is estimated that, by the year 2030, it will have become the third cause of death worldwide. Projective figures reported by the World Health Organization (WHO) regarding the increase in COPD affirm that these will remain the main causes of death worldwide until the year 2030 (*Chronic respiratory diseases*, n.d.).

Additionally, COPD is a disease with multiple comorbidities. Among the commonest of these found in the European SCA-3/MJD Initiative (ESMI) study are psychological disorders, anxiety (18.3%), or depression (15%), associated with risk of death (Almagro et al., 2015). The Global Initiative for Chronic Obstructive Lung Disease (GOLD, 2020) ((*Gold Reports for Personal Use*, n.d.) recognizes that patients frequently presented depression or anxiety as comorbidities and that both caused a negatively impact on the disease course, the control of symptoms, and Health-Related Quality of Life (HRQOL). In a systematic review, COPD patients with anxiety experienced their first hospitalization earlier compared with COPD patients without anxiety; the former also have higher rates of mortality and hospital re-admission after an exacerbation (Atlantis et al., 2013). It is known that the QOL of a chronic COPD patient can be especially complicated by depression, which can lead the patient to a vicious circle:

✉ Andrea Hernández-Pérez
andrea.hernandez@iner.gob.mx

1 Department of Research in Tobacco and COPD, National Institute of Respiratory Diseases Ismael Cosío Villegas, Calzada de Tlalpan 4502, Col. Sección XVI, Alcaldía Tlalpan, C.P. 14080 Mexico City, Mexico

2 Faculty of Higher Studies Zaragoza, National Autonomous University of México, Mexico City, Mexico

3 Department of Research in Stress and Health, Autonomous University of Madrid, Madrid, Spain

depressed mood will decrease the capacity needed to cope with chronic illness, physical symptoms will be less tolerable, and the exhausting effect of the disease may be related with depressed mood (Atlantis et al., 2013; Mewes et al., 2016). It has also been reported that depression doubles the risk of COPD emergency care, regardless of disease severity, or physical comorbidity (Blakemore et al., 2019). A recent meta-analysis, which was based on five eligible case–control studies, found that persons with history of COPD are more likely to commit suicide (Odds Ratio [OR] 1.90; 95% Confidence Interval [95% CI] 1.272.48; $p=0.002$) (Sampaio et al., 2019).

Especially in developing countries, COPD is associated with exposure to biomass smoke both in rural and urban areas (Camp et al., 2014; Pathak et al., 2020; Ramírez-Venegas et al., 2018) COPD due to Biomass (smoke) Exposure (COPD-BE) manifests with less emphysema but more air trapping, and also with more symptoms, more impact in activities and quality of life, and lower oxygen saturation at rest and during exercise compared to women with COPD due to exposure to tobacco smoke (COPD-TS) (Camp et al., 2014). However, we are unaware of studies of depression and anxiety in COPD-BE, likely to be, as in COPD-TS, a negative factor that adversely affected the disease course.

Therefore, the aim of this study was to determine the prevalence of affective comorbidity (depression, anxiety) and their relationship with lung function, dyspnea, and QOL in patients with COPD-BE in comparison with COPD-TS.

Materials and Methods

Design

This was an observational, cross-sectional study conducted in patients diagnosed with COPD-BE and in patients with COPD-TS, performed at the National Institute of Respiratory Diseases (INER), a public referral center for respiratory diseases mostly for uninsured and the economically deprived population of Metropolitan Mexico City.

Participants

A total of 291 patients were recruited from a cohort of patients from the INER COPD Clinic during their usual consultation. Eligible participants were aged between 60 and 85 years, with diagnosis of COPD according to American Thoracic Society/European Respiratory Society standards for diagnosis and treatment of patients with COPD, stable and without exacerbations in the last 6 weeks. Patients with COPD-BE were never smokers, who cooked with a biomass stove for at least 6 months and who had at least 100 h-years of exposure (the product of the number of years cooking with wood stoves multiplied by the average number of hours spent daily in the kitchen) (Pérez-Padilla et al., 2012; Ramírez-Venegas et al., 2018), whereas patients with COPD-TS were never exposed to biomass smoke during cooking and had at least 10 pack-years of cumulative smoking. We excluded patients with additional clinical diagnosis of sleep apnea, other chronic respiratory diseases (bronchiectasis, lung cancer, cystic fibrosis), or any acute or chronic condition that would limit the patient's ability to participate in the study. We used Mexican standard reference equations for predicted (pred) values of Forced Expiratory Volume in the first second (FEV_1) and for Forced Vital Capacity (FVC), which are similar to the third National Health and Nutrition Examination Survey values for Mexican-Americans (Pérez-Padilla et al., 2001).

Measures

To determine the prevalence of anxiety and depression, we applied the Hospital Anxiety and Depression Scale (HADS) validated in Mexican population, (Orozco et al., 2013) which is composed of 14 questions for the anxiety subscale and seven for the depression subscale (Zigmond & Snaith, 1983) The questions refer to the subject's well-being during the previous two weeks. Required short time (2 to 5 min) to complete the scale. Each question has four responses rated on a scale of 0–3, with a maximal score of 21 for each subscale (indicating a high level of depression and anxiety symptoms). Previous studies have suggested the limit for the depression subscale of 6 and of 8 for the anxiety subscale, which could produce a sensitivity of 0.82 (95% CI 0.73–80) and a specificity of 0.74 (95% CI 0.60–0.84) (Brennan et al., 2010; Snaith, 2003) Following standardized procedures by trained interviewers, a face-to-face evaluation was carried out by a Specialist Psychologist.

For each patient, the following information was collected: social demographics; biomass smoke exposure history; tobacco smoke exposure history; exacerbations in the previous year, and healthcare resource utilization during last 12 months. The level of dyspnea was measured using the modified scale of the Medical Research Council (mMRC) (Bestall et al., 1999). The COPD Assessment Test (CAT) was employed to evaluate the impact of the disease and symptoms, with scores of ≥ 10 indicating a very symptomatic patient (Jones et al., 2009). Each participant completed a 6-min walking test (6MWT) and the distance walked (6MWD) was calculated. We measured Oxygen Saturation (SaO_2) and heart rate using a pulse oximeter, at rest and at the end of the 6MWT.

Ethics Approval and Informed Consent

All patients signed an informed consent form, and the study was approved by the Ethics and Research Committee of the National Institute of Respiratory Diseases "Ismael Cosio Villegas" of Mexico City, with reference approval number C-2217.

Data Analysis

Statistical analysis was conducted by using SPSS ver. 19.0 statistical software (SPSS, Chicago, IL, USA). Normality distribution was tested by the Shapiro–Wilk test for numeric variables. Categorical variables were described by frequencies and percentages, while continuous variables with normal distribution were described using means and Standard Deviations (SD). We utilized ANalysis Of VAriance (ANOVA) and ANalysis of COVAriance (ANCOVA) or the Chi2 test to compare groups. We compared affective comorbidity symptoms (anxiety and depression) between COPD-BE and COPD-TS (women and men), using multiple regression lineal analysis, adjusted for age, sex, and FEV1, which are likely confounders for anxiety and depression scores. Finally, the association was evaluated with Pearson correlations and multiple hierarchical regression models to determine the main effects and interactions with anxiety and depression.

Results

A total of 291 patients with COPD were evaluated. There were 207 patients with COPD-TS and 84 patients with COPD-BE. The patients had a mean age of 72.8 ± 9.1 years, 55% (161) were male, a mean FEV_1 of 58 ± 24 (percentage of predicted FEV_1%), CAT of 9.6 ± 6.9, mMRC of 1.8 ± 1.1, and 6MWD of 382.4 ± 105.7 m. The prevalence of depression was 30.9% and there was one of 11.3% for anxiety in the total study population ($n = 291$) (Table 1).

Table 2 presents the results of the comparison of demographic data and lung function, and the symptoms, quality of life, and 6MWD between COPD-BE ($n = 85$), COPD-TS women ($n = 47$), and men COPD-TS ($n = 159$). Statistically significant differences between groups were found in age, height, and weight, lung function (FEV_1% pred, FEV1/FVC), and 6MWD.

The prevalence of depression was 41.2% in patients with COPD-BE vs. 27.7% in patients with COPD-TS women and 26.4% in COPD-TS men ($p < 0.05$). After being adjusted for age, sex, and FEV1% pred, we observed that the prevalence of depression and score was also higher in COPD-BE compared with other groups ($p < 0.05$). No difference was found in terms of anxiety among the groups (Table 3).

Table 1 General characteristics

	All patients $n = 291$
Exposures, *n* (%)	
Biomass exposure	84 (28.9)
Hour-years	314.5 ± 287.8
Tobacco exposure	207 (71.1)
Packs/year	43.8 ± 32.7
Demographic data	
Age, (years)	72.8 ± 9.1
Male *n* (%)	161 (55)
Height (cm)	157.4 ± 11.2
Weight (kg)	64.7 ± 17.1
BMI (kg/m^2)	26 ± 5.8
Lung function	
Post-bronchodilator	
FEV_1% pred	58.0 ± 24
FEV_1/FVC	52.8 ± 16.1
SaO_2%	87.8 ± 5.1
Symptoms, quality of life, and 6MWD	
mMRC score	1.8 ± 1.1
CAT score	9.6 ± 6.9
6MWD distance (m)	382.4 ± 105.7
Affective comorbidity	
Depression ≥ 6 prevalence *n* (%)	90 (30.9)
Score	4.3 ± 3.9
Anxiety ≥ 8 prevalence *n* (%)	33 (11.3)
Score	3.6 ± 3.4

Data are presented as mean ± Standard Deviation (SD)

BMI Body Mass Index; *FEV_1* Forced Expiratory Volume in 1 Second; *FVC* Forced Vital Capacity, *% pred* percentage predicted; *SaO_2* Oxygen Saturation; *mMRC* modified Medical Research Council dyspnea scale; *CAT* COPD Assessment Test; *6MWD* 6-min walking test

We also analyzed the association between depression and anxiety and sociodemographic and clinical variables. Table 4 depicts the correlations and linear regression analysis of the study variables ($n = 291$), CAT scores correlated best with the depression score ($r = 0.459$; $p < 0.01$) and the anxiety score ($r = 0.436$; $p < 0.01$). The depression score also had a significant association with mMRC (β = 1.48; 95% CI 1.06–2.07; $p = 0.021$) and CAT (β = 1.09; 95% CI 1.0–1.15; $p = 0.000$) in the multiple linear analysis. Anxiety was associated with CAT (β = 1.12; 95% CI 1.06–1.20; $p = 0.000$) and FEV_1% (β = 1.02; 95% CI 1.00–1.04; $p = 0.040$). On adjusting for age, post-bronchodilator FEV_1% did not alter these results.

Table 5 depicts the results of hierarchical multiple regression equation to determine the main and interaction effects of sociodemographic and clinical variables for predicting depression and anxiety. In the models to predict

Table 2 Comparison between the COPD-BE and COPD-TS groups

	COPD-BE	COPD-TS		*p* value
	Women	Women	Men	
	n = 85	*n* = 47	*n* = 159	
Demographic data				
Age, years	76 ± 7.5	71.2 ± 8.7	71.6 ± 9.6	0.001*
Biomass smoke exposure hours/years	298.5 ± 176.1	–	–	–
Tobacco smoke exposure pack/years	–	38.6 ± 24.8	45 ± 34.5	–
Height cm	145 ± 6.4	155.2 ± 7.7	164.6 ± 7.3	0.000*
Weight kg	54.9 ± 12.5	64.4 ± 19.9	70 ± 16.1	0.004
BMI kg/m^2	26.1 ± 5.4	26.6 ± 7.7	25.8 ± 5.4	0.666
Lung function				
Post-bronchodilator				
FEV_1% pred	69.8 ± 22.7	54.7 ± 20.4	52.6 ± 23.7	0.000*
FEV_1/FVC	57.2 ± 11	52.5 ± 12.4	48.1 ± 13.5	0.000*
SaO_2%	87.5 ± 5.1	88 ± 6.1	88 ± 4.8	0.79
Symptoms, quality of life, and 6MWD				
mMRC score	1.6 ± 1.0	1.9 ± 1.3	1.8 ± 1.1	0.433
CAT score	8.7 ± 6.7	11.4 ± 7.9	9.6 ± 6.7	0.097
6MWD distance (m)	338 ± 88.6	353.9 ± 110.3	413.1 ± 102.5	0.000*

The relationship is significant if $p \leq 0.05$. One-way ANOVA for continuous variables and chi-squared for categorical variables. Data are presented as mean ± Standard Deviation (SD)

ANOVA ANalysis Of VAriance; *BMI* Body Mass Index; *FEV_1* Forced Expiratory Volume in 1 Second; *FVC* Forced Vital Capacity; *% pred* percentage predicted; *SaO_2* Oxygen Saturation; *mMRC* modified Medical Research Council dyspnea scale; *CAT* COPD Assessment Test; *6MWD* 6-min walking test

*Statistically significant difference between groups

Table 3 Results of the affective comorbidity in groups

Affective comorbidity	COPD-BE Women *n* = 85	COPD-TS		Crude *p* value	Adjusted *p* value
		Women *n* = 47	Men *n* = 159		
Depression ≥ 6 prevalence % (*n*)	35 (41.2)	13 (27.7)	42 (26.4)	0.052	0.028*
Score	5.3 ± 4.2	4.2 ± 4.1	3.9 ± 3.6	0.024	0.016*
Anxiety ≥ 8 prevalence % (*n*)	13 (15.3)	5 (10.6)	15 (9.4)	0.383	0.192
Score	4.1 ± 3.8	3.8 ± 3.3	3.2 ± 3.1	0.158	0.095

Data are presented as mean ± Standard Deviation (SD) or percent of prevalence (%). Crude *p* value of ANOVA; Chi-square as appropriate. Adjusted *p* value of ANCOVA corrected for age and FEV1%

ANOVA ANalysis Of VAriance; *ANCOVA* ANalysis of COVAriance

*Statistically significant difference between groups

the depression and anxiety scores, first, sociodemographic variables age and sex were introduced to control their possible effects. Then, the clinical variables (mMRC, 6MWD, CAT, and FEV1% pred) were introduced. In the multivariate analysis, age and sex alone explained 3% and 1%, respectively, of the anxiety and depression variance, and mMRC and CAT were significantly associated with anxiety and depression scores and explained 25% and 24%, respectively, of the variability.

Discussion

We described (for the first time, to our knowledge) the high prevalence in depression and anxiety comorbidities in COPD associated with biomass smoke. The prevalence of depression in COPD-BE was nearly twice that of COPD-TE (women and men). COPD-BE exhibited better lung function, but also presented a worse Quality-Of Life (QOL) measurement by the CAT questionnaire compared

Table 4 Pearson correlations and linear regression analysis of affective comorbidity with all variables

Variables	Depression			Anxiety		
	r	*p* value	*β* (95% CI), *p* value	*r*	*p* value	*β* (95% CI), *p* value
Age	0.06	0.306	1.00 (0.96, 1.03), 0.896	−0.09	0.14	0.99 (0.93,1.04), 0.745
mMRC	0.365	0	1.48 (1.06, 2.07), 0.021*	0.222	0	1.31 (0.78, 2.18), 0.296
CAT	0.459	0	1.09 (1.04, 1.15), 0.000*	0.436	0	1.12 (1.06, 1.20), 0.000*
FEV_1% pred	−0.03	0.654	1.00 (0.98, 1.01), 0.592	0.009	0.873	1.02 (1.00, 1.04), 0.040*
6MWD	−0.25	0	0.99 (0.99, 1.00), 0.589	−0.01	0.876	1.00 (1.00, 1.01), 0.070

r, Pearson correlation; *p* value, Statistical Significance

mMRC modified Medical Research Council dyspnea scale; *CAT* COPD Assessment Test; *FEV_1* Forced Expiratory Volume in 1 Second; *% pred* percentage predicted; *6MWD* 6-min walking test

*Statistically significant

Table 5 Hierarchy multiple regression analysis

Step and variables	Anxiety		Depression	
	β step 1	β step 2	β step 1	β step 2
Control variables	−0.09	−0.07	−0.03	−0.03
Age (years)	−0.160*	−0.185**	−0.145***	-0.113*
Male				
Main effects		0.136*		0.347**
mMRC		0.122*		0.109
FEV_1%		0.197**		−0.03
6MWD		0.438**		0.347**
CAT				
R	0.173	0.503	0.153	0.507
R^2	0.03	0.253	0.016	0.24

β values correspond to standardized regression coefficients

mMRC modified Medical Research Council dyspnea scale; *FEV_1* Forced Expiratory Volume in 1 Second; *% pred* percentage predicted; *6MWD* 6-min walking test; *CAT* COPD Assessment Test

*$p < 0.05$; **$p < 0.01$

with COPD-TS. In a previous study, on matching for age and severity of airflow obstruction, women exposed to biomass smoke had a lower QOL and more hypoxemia than smokers (Camp et al., 2014).

Women with COPD have been reported to have higher negative affective comorbidity than men. Women had higher susceptibility to the negative effects of COPD on health status (SGRQ total and impact scores) (Antonelli-Incalzi et al., 2003), and appear to be more susceptible to psychological impairment, which correlates with some specific symptomatic aspects of the disease, such as dyspnea (Di Marco et al., 2006).

It was surprising for us to observe the high prevalence of depression in COPD-BE compared with COPD-TE (women and men) in our cohort. Usually, women with COPD-BE are unaware of the damage caused by the use of wood for cooking, but also that they present depression or anxiety. In addition, they tend to delay medical consultation until their symptoms are severe, or until they experience a moderate to severe exacerbation. Women with COPD-BE needed to resolve other priorities, not mood alterations to such a great extent, and are unaware of depressive and anxiety terms. Even we asked them, they tended to deny symptoms. On asking about specific depressive or anxiety symptoms by employing a questionnaire such as the HADS, we can identify that these women suffer from depression and anxiety. A hypothesis of underreporting in anxiety and depression symptoms could come from the contextual situation in Mexico, being a population with low economic resources and a lower educational level.

The great majority of information on the prevalence of affective comorbidity in COPD has derived from patients with COPD-TS; the interaction of depression and anxiety in patients with COPD-BE was unknown. Therefore, it was very relevant to evaluate the effective comorbidity in this vulnerable group, which also requires interventions adapted to socioeconomic conditions, in that these variables can interact as mediators or moderators in anxiety and depression. In addition, considering that the presence of anxiety and depression as comorbidities in COPD contribute to a substantial burden of COPD-related morbidity by impairing QOL and reducing treatment adherence (Hanania & O'Donnell, 2019; Khdour et al., 2012; Miravitlles et al., 2017; Pooler & Beech, 2014; Yohannes et al., 2018) In particular, depression has been identified as an independent risk factor for frequent exacerbations (Deng et al., 2020). The results we obtained indicate that it is justified to identify people with the symptoms of anxiety and depression (particularly occurring simultaneously) to provide them with additional psychological and therapeutic support in order not to further exacerbate the disorder but to reduce and eliminate it. The mental health and public health implications of these results are necessary to prioritize routine psychological evaluation in COPD patients, not only the tobacco-related phenotype, but also in patients with the biomass phenotype, being a vulnerable population in the social sense and psychological, it is important to provide the patient with tools

that will allow him to live with the disease in the best possible way and avoid its psychological effects.

We assessed the relationship between affective comorbidity (anxiety, depression) with pulmonary function, dyspnea, exercise capacity, and health-related QOL in these populations. The multivariate model developed with all of the study variables study demonstrated the association of affective comorbidity scores and the usual characteristics of COPD severity (degree of dyspnea, symptoms, and exercise capacity 6MWD). This model explains up to 25.3% of anxiety variability and 24.0% of depression variability. Our results coincide with those reported in other investigations of associations of affective comorbidity and clinical variables (Hanania & O'Donnell, 2019; Mathew et al., 2019; Mewes et al., 2016; Pascal et al., 2017; Yohannes et al., 2018).

In our population, anxiety and depression were associated with higher CAT and dyspnea, scores reflecting poorer QOL and also increased breathlessness. Other studies had reported similar results. Dua et al. (2018), in an observational, prospective, multicenter study of 128 patients with and without psychiatric comorbidities, both baseline dyspnea scores of mMRC ($p = 0.002$) and CCQ scores for QOL ($p < 0.001$) were significantly higher in patients with psychiatric comorbidity. Ramírez-Venegas et al. (2018) showed that in COPD-BE, the prevalence of cough, phlegm, and wheezing are higher but, on the other hand, lung function was more preserved than in COPD-TS (Ramírez-Venegas et al., 2006; Regalado et al., 2006).

Finally, more recent evidence highlighted the effect of inflammation on the mood of COPD (Ding et al., 2021; Long et al., 2020). Systemic inflammation runs through the COPD patient's entire life cycle because of the disease, from the airways to the target organs and tissues throughout the body and may be related to its comorbidities such as anxiety and depression. Hence, it is necessary to find how these inflammatory markers change in COPD during acute exacerbation, and whether there are some potential associations with depression and/or anxiety, deserve further research. Which contributes to highlighting the importance of promoting coping skills and developing resilience to reduce effective comorbidity.

Limitations

Our analysis is only cross-sectional survey and temporal sequence of COPD, and the affective symptoms or the impact on exacerbations cannot be determined. The analysis of depressive and anxiety symptoms should be considered from a proximal perspective, at the present time, it would be worth evaluating longitudinally, which allows a long-term analysis in these variables. Poverty is associated with biomass smoke exposure and is also a marker of access to healthcare, nutrition, and vaccination, impacting general health and the risk for COPD and may also exert an effect on affective comorbidity. The women who were recruited to participate in this study were seen at the national hospital for low-income residents; thus, current socioeconomic status between the groups was probably similar. Nevertheless, we cannot assess the impact of other factors that can mediate or moderate anxiety and depression, such as social support, emotional regulation, or personality characteristics.

Conclusion

Women with COPD-BE, common in developing countries, have a high prevalence of affective comorbidity. It is very relevant to assess affective comorbidity and intervene early in a routine manner in these patients. Failure to intervene in this comorbidity renders these women with COPD-BE more susceptible to having more exacerbations and a worse quality of life. As recommended for COPD, comorbidities should be identified, including psychological comorbidities, and comprehensive care should be offered to patients by an interdisciplinary team.

Acknowledgements We thank to the Council of Science and Technology Mexico (CONACYT) for a doctoral grant that AH-P received [Granter Number: 286181], and the participating health professionals and patients with COPD who made this study possible by their enthusiastic participation.

Author Contributions AH collected the data and drafted the manuscript. RP and IV revised the manuscript for submission. AH and AR completed the analysis and assisted in drafting paper. BM provided overall guidance on paper structure and content and revised early drafts. All authors read and approved the final manuscript.

Funding None.

Declarations

Conflict of interest The authors declare that they have no competing interests.

Research Involving Human and Animal Rights All Procedures performed in studies involving human participants were in accordance with the ethical standards of National Institute of Respiratory Diseases Ismael Cosío Villegas Mexico and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by the authors.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

Almagro, P., Cabrera FJ., J Diez-Manglano., R Boixeda., J Mercade., ... Soriano, J. B. (2015). Comorbidome and short-term prognosis

in hospitalised COPD patients: The ESMI study. *European Respiratory Journal, 46*(3), 850–853. https://doi.org/10.1183/09031936.00008015

Antonelli-Incalzi, R., Imperiale, C., Bellia, V., Catalano, F., Scichilone, N., Pistelli, R., & Rengo, F. (2003). Do GOLD stages of COPD severity really correspond to differences in health status? *European Respiratory Journal, 22*(3), 444. https://doi.org/10.1183/09031936.03.00101203

Atlantis, E., Fahey, P., Cochrane, B., & Smith, S. (2013). Bidirectional associations between clinically relevant depression or anxiety and COPD: A systematic review and meta-analysis. *Chest, 144*(3), 766–777. https://doi.org/10.1378/chest.12-1911

Bestall, J. C., Paul, E. A., Garrod, R., Garnham, R., Jones, P. W., & Wedzicha, J. A. (1999). Usefulness of the Medical Research Council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. *Thorax, 54*(7), 581–586. https://doi.org/10.1136/thx.54.7.581

Blakemore, A., Dickens, C., Chew-Graham, C. A., Afzal, C. W., Tomenson, B., Coventry, P. A., & Guthrie, E. (2019). Depression predicts emergency care use in people with chronic obstructive pulmonary disease: A large cohort study in primary care. *International Journal of Chronic ObstRuctive Pulmonary Disease, 14*, 1343–1353. https://doi.org/10.2147/COPD.S179109

Brennan, C., Worrall-Davies, A., McMillan, D., Gilbody, S., & House, A. (2010). The Hospital Anxiety and Depression Scale: A diagnostic meta-analysis of case-finding ability. *Journal of Psychosomatic Research, 69*(4), 371–378. https://doi.org/10.1016/j.jpsychores.2010.04.006

Camp, P. G., Ramirez-Venegas, A., Sansores, R. H., Alva, L. F., McDougall, J. E., Sin, D. D., Pare, P. D., Muller, N. L., Silva, C. I. S., Rojas, C. E., & Coxson, H. O. (2014). COPD phenotypes in biomass smoke- versus tobacco smoke-exposed Mexican women. *European Respiratory Journal, 43*(3), 725–734. https://doi.org/10.1183/09031936.00206112

Chronic respiratory diseases. (n.d.). Retrieved June 1, 2020, from https://www.who.int/westernpacific/health-topics/chronic-respiratory-diseases

Deng, D., Zhou, A., Chen, P., & Shuang, Q. (2020). CODEXS: A new multidimensional index to better predict frequent COPD Exacerbators with inclusion of depression score. *International Journal of Chronic Obstructive Pulmonary Disease, 15*, 249–259. https://doi.org/10.2147/COPD.S237545

Di Marco, F., Verga, M., Reggente, M., Maria Casanova, F., Santus, P., Blasi, F., Allegra, L., & Centanni, S. (2006). Anxiety and depression in COPD patients: The roles of gender and disease severity. *Respiratory Medicine, 100*(10), 1767–1774. https://doi.org/10.1016/j.rmed.2006.01.026

Ding, K. Q., Lai, Z. H., Zhang, Y., Yang, G. Y., He, J. R., & Zeng, L. L. (2021). Monocyte-to-lymphocyte ratio is associated with depression 3 months after stroke. *Neuropsychiatric Disease and Treatment, 17*, 835–845. https://doi.org/10.2147/NDT.S299462

Dua, R., Das, A., Kumar, A., Kumar, S., Mishra, M., & Sharma, K. (2018). Association of comorbid anxiety and depression with chronic obstructive pulmonary disease. *Lung, 35*(1), 31–36. https://doi.org/10.4103/lungindia.lungindia_537_16

Hanania, N. A., & O'Donnell, D. E. (2019). Activity-related dyspnea in chronic obstructive pulmonary disease: Physical and psychological consequences, unmet needs, and future directions. *International Journal of Chronic Obstructive Pulmonary Disease, 14*, 1127–1138. https://doi.org/10.2147/COPD.S188141

Jones, P. W., Harding, G., Berry, P., Wiklund, I., Chen, W.-H., & Kline Leidy, N. (2009). Development and first validation of the COPD Assessment Test. *European Respiratory Journal, 34*(3), 648. https://doi.org/10.1183/09031936.00102509

Khdour, M. R., Hawwa, A. F., Kidney, J. C., Smyth, B. M., & McElnay, J. C. (2012). Potential risk factors for medication non-adherence in patients with chronic obstructive pulmonary disease (COPD). *European Journal of Clinical Pharmacology, 68*(10), 1365–1373. https://doi.org/10.1007/s00228-012-1279-5

Long, J., Ouyang, Y., Duan, H., Xiang, Z., Ma, H., Ju, M., & Sun, D. (2020). Multiple factor analysis of depression and/or anxiety in patients with acute exacerbation chronic obstructive pulmonary disease. *International Journal of Chronic Obstructive Pulmonary Disease, 15*, 1449–1464. https://doi.org/10.2147/COPD.S245842

Mathew, A. R., Yount, S. E., Kalhan, R., & Hitsman, B. (2019). Psychological functioning in patients with chronic obstructive pulmonary disease: A preliminary study of relations with smoking status and disease impact. *Nicotine & Tobacco Research, 21*(5), 686–690. https://doi.org/10.1093/ntr/nty102

Mewes, R., Rief, W., Kenn, K., Ried, J., & Stenzel, N. (2016). Psychological predictors for health-related quality of life and disability in persons with chronic obstructive pulmonary disease (COPD). *Psychology & Health, 31*(4), 470–486. https://doi.org/10.1080/08870446.2015.1111369

Miravitlles, M., Izquierdo, J. L., Esquinas, C., Pérez, M., Calle, M., López-Campos, ... de Lucas, P. (2017). The variability of respiratory symptoms and associated factors in COPD. *Respiratory Medicine, 129*, 165–172. https://doi.org/10.1016/j.rmed.2017.06.017

Orozco, M. J. N., Terán, B. P., Casarrubias, V. B., & García, R. R. (2013). Escala de Ansiedad y Depresión Hospitalaria (hads): validación en pacientes mexicanos con infección por vih. *Psicología Iberoamericana, 21*(2), 29–37.

Pascal, O. I., Trofor, A. C., Lotrean, L. M., Filipeanu, D., & Trofor, L. (2017). Depression, anxiety and panic disorders in chronic obstructive pulmonary disease patients: Correlations with tobacco use, disease severity and quality of life. *Tobacco Induced Diseases, 15*, 23–23. https://doi.org/10.1186/s12971-017-0128-9

Pathak, U., Gupta, N. C., & Suri, J. C. (2020). Risk of COPD due to indoor air pollution from biomass cooking fuel: A systematic review and meta-analysis. *International Journal of Environmental Health Research, 30*(1), 75–88. https://doi.org/10.1080/09603123.2019.1575951

Pérez-Padilla, J. R., Regalado-Pineda, J., & Vázquez-García, J. C. (2001). Reproducibilidad de espirometrías en trabajadores mexicanos y valores de referencia internacionales. *Salud Pública De México*. https://doi.org/10.1590/S0036-36342001000200006

Pérez-Padilla, R., Regalado, J., Vedal, S., Paré, P., Chapela, R., Sansores, R., & Selman, M. (2012). Exposure to biomass smoke and chronic airway disease in Mexican women. A case–control study. *American Journal of Respiratory and Critical Care Medicine*. https://doi.org/10.1164/ajrccm.154.3.8810608

Pooler, A., & Beech, R. (2014). Examining the relationship between anxiety and depression and exacerbations of COPD which result in hospital admission: A systematic review. *International Journal of Chronic Obstructive Pulmonary Disease*. https://doi.org/10.2147/COPD.S53255

Ramírez-Venegas, A., Sansores, R. H., Pérez-Padilla, R., Regalado, J., Velázquez, A., Sánchez, C., & Mayar, M. E. (2006). Survival of patients with chronic obstructive pulmonary disease due to biomass smoke and tobacco. *American Journal of Respiratory and Critical Care Medicine, 173*(4), 393–397. https://doi.org/10.1164/rccm.200504-568OC

Ramírez-Venegas, A., Velázquez-Uncal, M., Pérez-Hernández, R., Guzmán-Bouilloud, N. E., Falfán-Valencia, R., Mayar-Maya, M. E., Aranda-Chávez, A., & Sansores, R. H. (2018). Prevalence of COPD and respiratory symptoms associated with biomass smoke exposure in a suburban area. *International Journal of Chronic Obstructive Pulmonary Disease, 13*, 1727–1734. https://doi.org/10.2147/COPD.S156409

Regalado, J., Pérez-Padilla, R., Sansores, R., Páramo Ramirez, J. I., Brauer, M., Paré, P., & Vedal, S. (2006). The effect of biomass burning on respiratory symptoms and lung function in rural

Mexican women. *American Journal of Respiratory and Critical Care Medicine, 174*(8), 901–905. https://doi.org/10.1164/rccm.200503-479OC

Gold Reports for Personal Use. (n.d.). Global Initiative for Chronic Obstructive Lung Disease - GOLD. Retrieved June 2, 2020, from https://goldcopd.org/gold-reports/

Sampaio, M. S., Vieira, W. A., Bernardino, Í. M., Herval, Á. M., Flores-Mir, C., & Paranhos, L. R. (2019). Chronic obstructive pulmonary disease as a risk factor for suicide: A systematic review and meta-analysis. *Respiratory Medicine, 151*, 11–18. https://doi.org/10.1016/j.rmed.2019.03.018

Snaith, R. P. (2003). The hospital anxiety and depression scale. *Health and Quality of Life Outcomes, 1*, 29–29. https://doi.org/10.1186/1477-7525-1-29

Yohannes, A. M., Kaplan, A., & Hanania, N. A. (2018). Anxiety and depression in chronic obstructive pulmonary disease: Recognition and management. *Cleveland Clinic Journal of Medicine, 85*(2 suppl 1), S11. https://doi.org/10.3949/ccjm.85.s1.03

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica, 67*(6), 361–370. https://doi.org/10.1111/j.1600-0447.1983.tb09716.x

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.