CHEST

Original Research

COPD

The Impact of Disability on Depression Among Individuals With COPD

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Background: **Both disability and depression are common in COPD, but limited information is available on the time-ordered relationship between increases in disability and depression onset.**
Methods: **Subjects were members of a longitudinal cohort with self-reported physician-diagnosed COPD, emphysema, or chronic bronchitis. Data were collected through three annual structured telephone interviews (T1, T2, and T3). Depression was defined as a score ≥ 4 on the Geriatric Depression Scale Short Form (S-GDS). Disability was measured with the Valued Life Activities (VLA) scale; three disability scores were calculated: percent of VLAs unable to perform, percent of VLAs affected (unable to perform or with some degree of difficulty), and mean VLA difficulty rating. Disability increases were defined as a 0.5 SD increase in disability score between T1 and T2. Multiple logistic regression analyses estimated the risk of T3 depression following a T1 to T2 disability increase for the total cohort and then excluding individuals who met the depression criterion at T1 or T2.**
Results: **Approximately 30% of subjects met the depression criterion each year. Eight percent to 19% experienced a T1 to T2 disability increase, depending on the disability measure. Including all cohort members and controlling for baseline S-GDS scores, T1 to T2 increases in disability yielded a significantly elevated risk of T3 depression (% affected odds ratio [OR] = 3.6; 95% CI, [1.7, 7.7]; % unable OR = 6.1 [17, 21.8]; mean difficulty OR = 3.6 [1.7, 8.0]). Omitting individuals depressed at T1 or T2 yielded even stronger risk estimates for % unable (OR = 13.4 [2.0, 91.4]) and mean difficulty (OR = 3.9 [1.3, 11.8]).**
Conclusions: **Increases in VLA disability are strongly predictive of the onset of depression.**

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Abbreviations: CB = chronic bronchitis; % affected = proportion of VLAs affected (either unable to perform or with some degree of difficulty); % unable = proportion of VLAs unable to perform; S-GDS = Geriatric Depression Scale Short Form; T1 = time 1 (2006); T2 = time 2 (2007); T3 = time 3 (2008); VLA = valued life activities

A high prevalence of depressive disorders and depressive symptoms has been noted among persons with COPD.[1-7] Although depression is more common in chronic diseases generally, the prevalence among persons with COPD is particularly high. Individuals with COPD also have greater levels of disability than persons of comparable age in the general population.[8] This disability may be seen in a broad spectrum of life activities.[9-18] Despite the fact that disability is common among individuals with COPD, relatively little is known about the progression of disability or what comorbidities or disease-related factors may influence the course of disability.

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Studies among persons with COPD, other chronic health conditions, and in the general elderly population have noted that worse functioning is linked to depression and psychological distress.[3,4,9,19-27] Most studies, however, have demonstrated either cross-sectional associations between disability and depression or correlations between changes in functioning and changes in distress. Very few studies have established the time ordering between changes in disability and changes in depressive symptoms or distress, although one study did report that becoming unable to perform valued life activities (VLAs) strongly predicted later onset of new depressive symptoms among adults with rheumatoid arthritis.[28,29] If a similar pattern of progression were established in COPD, it might provide one answer to a high-priority question from the American College of Chest Physicians Workshop Panel on Anxiety and Depression in COPD: "What are the early predictors of depression and anxiety in COPD that may lead to the development of preventive strategies?"[30]

The primary aim of this article is to examine the relationship between increases in disability and depressive symptoms among individuals with COPD, specifically whether a time-ordered relationship can be clearly identified. In addition, we report on the prevalence of high levels of depressive symptoms and disability increases in a population-based cohort of individuals with COPD.

Materials and Methods

Sample

We used data from three waves of a population-based, longitudinal cohort study of US adults with various airways diseases, aged 55 to 75 years at recruitment.[17,31] During recruitment, subjects were asked if they had been diagnosed by a medical doctor with chronic bronchitis, emphysema, COPD, or asthma; if so, they were included in the airways disease cohort. Annual retention among the original sample averaged approximately 80% through 2006, over five follow-up telephone interviews (2002-2006). In 2006, another 375 individuals were recruited from Northern California using the original recruitment method, yielding 243 who reported COPD or emphysema and 209 who reported chronic bronchitis without concomitant COPD or emphysema; the remaining individuals reported only asthma and are not included in these analyses. We defined two nonoverlapping condition groups for these analyses based on participants' self-reports: (1) COPD/emphysema with or without concomitant chronic bronchitis (COPD) and (2) chronic bronchitis with or without concomitant reports of asthma (CB), but with no self-report of COPD or emphysema.

Follow-up telephone interviews were conducted annually by trained survey workers. In 2007, 384 individuals (85% of 2006 respondents) completed the follow-up interview, and 341 completed the 2008 interview (89% of 2007 respondents). For the remainder of this article, 2006 (baseline for the supplemental recruitment) is referred to as T1, 2007 as T2, and 2008 as T3.

The study was designed specifically to examine disability and depressive symptoms among individuals with COPD; no interventions were conducted. The study was approved by the University's Committee on Human Research.

Variables

Disability: Disability was measured using the VLA scale, which assesses difficulty in functioning in 28 activity domains, ranging from self-care to household chores to social and recreational activities.[17] In other health conditions, the VLA disability scale is a robust predictor of satisfaction with function, psychologic distress, quality of life, and self-rated health[28,29,32-34] and in COPD has been linked to quality of life and self-rated health.[34,35] Respondents rate difficulty caused by their condition in each life activity (0 = no difficulty, 1 = a little difficulty, 2 = a lot of difficulty, and 3 = unable to perform). Activities that respondents deem unimportant to themselves, that they do not perform for reasons unrelated to their respiratory condition, or are not applicable to respondents are not rated or included in scoring. Summary scores calculated for this study were the proportion of activities individuals are unable to perform (% unable), proportion of activities affected (unable to perform or able to perform but with some level of difficulty; % affected), and mean difficulty score (which has a theoretical range of 0-3).

Depression: Depressive symptoms were assessed with the Geriatric Depression Scale Short Form (S-GDS).[36] The S-GDS has been validated in nongeriatric populations as well as in younger adults with obstructive lung disease,[37-41] and has been validated for use by telephone interview.[42] It was developed to counter the overlap between symptoms of physical illness and somatic aspects of depression, such as fatigue or difficulty sleeping. Total scores range from 0 to 15. A cut score of 3/4 has been shown to correctly classify 79% of individuals with mood disorders, with a sensitivity of 67% and specificity of 82%.[43] Using a higher cut score to identify only major depressive disorder increases correct classification (to 86%), but in the correspondence study, minor depression was as prevalent as major depressive disorder. Because subsyndromal depressive symptoms are associated with disability and place individuals at risk for development of major depressive disorder,[44] we chose to use the lower cut score. For the purposes of these analyses, individuals with S-GDS scores of ≥ 4 will be referred to as "depressed," although we recognize that meeting the S-GDS criterion is not equivalent to a clinical diagnosis of depression.

Other Measures

Age, sex, race, education, and smoking history were collected in the telephone interview. Smoking history was classified as current, former, or never. Participants were asked whether a physician had diagnosed any of the following comorbid conditions: high BP, heart disease, diabetes, arthritis, cancer, stroke, or kidney disease. For analysis, individuals were categorized as having 0, 1, or ≥ 2 of these comorbid conditions.

The COPD Severity Score was used as a composite measure of disease severity.[45] The COPD Severity Score is a validated measure based on respiratory symptoms, systemic corticosteroid use, other COPD medication use, previous hospitalization or intubation for respiratory disease, and home oxygen use. It has been shown to have excellent performance characteristics for COPD and CB; to correlate with, but be independent of, airflow measured by spirometry; to correlate with 6-min walk test results; and to be responsive to changes in disease severity.[45-47]

Statistical Analysis

Characteristics of subjects with COPD and CB and with and without T1 depression were compared with χ^2 analyses and *t* tests. Odds of depression among patients with COPD vs CB were estimated with logistic regression analyses. Differences in T1

disability scores between depressed and nondepressed individuals were evaluated with *t* tests.

T1-T2 changes in disability scores were calculated by subtracting T1 scores from T2 scores. A disability increase was defined by an increase of 0.5 SD of the baseline score for that particular measure, yielding the following criteria for defining increases: increase $\geq 10\%$ in % affected, increase $\geq 5\%$ in % unable, and an increase ≥ 0.19 in mean VLA difficulty. The 0.5 SD change has been shown to approximate a minimal clinically important difference.[48,49] Odds of disability increase for COPD compared with CB were estimated with logistic regression analyses.

Bivariate logistic regression analyses estimated the odds of T3 depression following a T1 to T2 disability increase. Multivariate analyses repeated this estimation, controlling for age, sex, race, education, smoking status, comorbidities, COPD Severity Score, baseline value of the disability measure, and baseline S-GDS score. Bivariate and multivariate logistic regression analyses were conducted for the entire sample, and then separately for each condition group. Multivariate analyses within condition groups adjusted for fewer covariates (age, sex, COPD Severity Score, and baseline value of the disability measure) because of the smaller sample sizes.

The final set of analyses repeated the logistic regression analyses described above, but omitted individuals who met the depression criterion at T1 or T2. This permitted us to examine the role of increased disability in the onset of depression with clear time ordering of the disability increase and onset of depression. All analyses were conducted first with the total sample and then separately for the COPD and CB groups.

Results

Subject Characteristics

The majority of the sample was aged 66 years and older, women, and past or current smokers. Additional sample characteristics are presented in Table 1. The COPD group was older, more likely to be current or former smokers, and had higher disease severity scores.

Nearly one-third of those studied (34.5%, n = 186) met the depression criterion at T1. Individuals who were depressed were more likely to have less than high school education, be current smokers, have more comorbid conditions, and have significantly higher COPD Severity Scores than the group reporting CB alone. Individuals who were depressed at T1 were also more likely to be lost to follow-up at T3 (35.3% vs 18.9%, $P = .0002$).

Prevalence of Depression

The prevalence of depression was fairly stable over time (Table 2) and was more common in COPD than CB. However, after adjustment for demographics, smoking, comorbidities, and disease severity, differences in prevalence of depression between the groups were no longer significant.

T1 Disability and Depression

Substantial disability was evident at T1, and greater disability was evident among depressed individuals (Table 3). The depressed group reported a mean of 64.8% of VLAs affected and were unable to perform 12.8% of VLAs, compared with 23.5% affected and 1.7% unable for the nondepressed group. Similar significant differences were noted between depressed and nondepressed individuals within each condition group.

T1 to T2 Increases in Disability

Between 8% to 19% of the cohort experienced a T1 to T2 disability increase, depending on the disability measure considered (Table 4). Compared with CB, unadjusted odds of increased disability were significantly higher for COPD, but after adjustment for covariates, differences between the groups in the prevalence of disability increase were not significant.

T1 to T2 Increases in Disability and T3 Depression

Individuals who experienced a T1 to T2 disability increase were more likely to be depressed at T3 (Table 5). Unadjusted odds of T3 depression were significantly elevated for individuals with increases in % affected, % unable, and mean difficulty. After adjustment for covariates, the odds of depression remained significantly elevated.

The final analysis also examined the relationship between T1 to T2 disability increases and T3 depression, but excluded individuals whose depression scores were ≥ 4 (the threshold to be classified as depressed) at T1 or T 2. This analysis permitted a clearer examination of the time ordering of changes in disability and onset of depression. T1 to T2 increases in % unable and mean difficulty were significant predictors of the onset of new depression at T3. These relationships remained significant after adjustment for covariates. No significant associations were noted between increases in % affected, although the odds ratios were elevated. Results for these analyses within the condition subgroups yielded similar results (data not shown).

Discussion

Depression was common in this cohort of individuals with COPD and CB; approximately one-third of the cohort met the screening criterion each year. Previous studies have estimated the prevalence of depression in COPD at 7% to 60%,[2,5,7,50] with the broad range of estimates perhaps attributable to the wide variability in the number and characteristics of subjects and method of estimating depression.

In our analyses, crude depression rates were higher for individuals reporting a diagnosis of COPD than for those reporting CB alone. After adjustment for

Table 1—*Subject Characteristics at Time 1*

	Total Sample (N = 452)	Condition Group			Total Sample, By Time 1 Depressive Symptoms		
		COPD (n = 243)	Chronic Bronchitis (n = 209)	*P* Value[a]	S-GDS < 4 (n = 296)	S-GDS ≥ 4 (n = 156)	*P* Value[a]
Age, % (No.)							
55-60 y	19.0 (86)	15.6 (38)	23.0 (48)	.003	17.6 (52)	21.8 (34)	.55
61-65 y	27.4 (124)	23.5 (57)	32.1 (67)		27.7 (82)	26.9 (42)	
≥ 66 y	53.5 (242)	60.9 (148)	45.0 (94)		54.7 (162)	51.3 (80)	
Female, % (No.)	61.3 (277)	57.6 (140)	65.6 (137)	.10	60.8 (180)	62.2 (97)	.84
White, non-Hispanic, % (No.)	90.9 (441)	91.1 (216)	90.7 (185)	.87	90.7 (264)	91.3 (137)	.83
Education less than high school, % (No.)	9.5 (43)	11.9 (29)	6.7 (14)	.08	6.1 (18)	16.0 (25)	.001
Smoking status, % (No.)							
Never	23.2 (105)	10.3 (80)	38.3 (80)	< .0001	26.7 (79)	16.7 (26)	.0002
Former smoker	55.3 (250)	62.1 (151)	47.4 (99)		56.4 (167)	53.2 (83)	
Current smoker	21.5 (97)	27.6 (67)	14.4 (30)		16.9 (50)	30.1 (47)	
Comorbid conditions, % (No.)							
0	19.7 (89)	16.9 (41)	23.0 (48)	.16	25.3 (75)	9.0 (14)	< .0001
1	31.6 (143)	30.9 (75)	32.5 (68)		35.8 (106)	23.7 (37)	
≥ 2	48.7 (220)	52.3 (127)	44.5 (93)		38.9 (115)	67.3 (105)	
COPD Severity Score, mean (SD)	7.5 (6.3)	9.7 (6.8)	4.9 (4.5)	< .0001	5.6 (5.1)	11.1 (6.9)	< .0001

COPD = self-reported diagnosis of COPD or emphysema; chronic bronchitis = self-reported diagnosis of chronic bronchitis without concomitant self-report of COPD or emphysema; S-GDS = Geriatric Depression Scale Short Form.
[a]*P* value from χ^2 analyses or *t* tests comparing groups.

sociodemographic characteristics, comorbidities, and disease severity, however, the risk of depression was not significantly different for the two groups, suggesting that sociodemographic and health-related characteristics associated with the conditions are the critical factors associated with depression.

Table 2—*Prevalence of Depression*

	Total Cohort	COPD	Chronic Bronchitis
Time 1			
No.	452	243	209
% (No.) depressed	34.5 (156)	42.0 (102)	25.8 (54)
Odds of depression, OR (95% CI)[a]			
Unadjusted	…	2.1 (1.4, 3.1)	…
Adjusted[b]	…	0.8 (0.5, 1.5)	…
Time 2			
No.	384	201	183
% (No.) depressed	31.5 (121)	36.8 (74)	25.7 (47)
Odds of depression, OR (95% CI)[a]			
Unadjusted	…	1.7 (1.1, 2.6)	…
Adjusted[b]	…	1.1 (0.6, 2.2)	…
Time 3			
No.	341	173	168
% (No.) depressed	32.3 (110)	36.4 (63)	28.0 (47)
Odds of depression, OR (95% CI)[a]			
Unadjusted	…	1.5 (0.9, 2.3)	…
Adjusted[b]	…	0.9 (0.5, 1.7)	…

Depression defined as high levels of depressive symptoms, S-GDS score ≥ 4. OR = odds ratio. See Table 1 for expansion of abbreviations.
[a]Reference for analysis is chronic bronchitis group.
[b]Adjusted for age, sex, race, education, marital status, smoking status, comorbidities, and COPD Severity Score.

Previous studies have shown that disability is common among individuals with COPD. For example, in this same cohort, we have reported that 94% of individuals with COPD had at least one VLA domain affected by COPD, and almost one-half were unable to perform at least one VLA. In the current study, we found that increases in disability were also relatively common. Over a 1-year period, between 8% and 19% of the cohort experienced a disability increase, depending on how disability was defined. Differences in the prevalence of disability increases between condition groups again appeared to be more closely related to T1 sociodemographic and health characteristics than to the specific condition. Further study is needed to determine if these rates of disability increase continue over longer periods of time.

Disability increases were significantly associated with the subsequent onset of depressive symptoms. Including the entire cohort, an increase in disability, regardless of how it was measured, at least doubled the risk of later depressive symptoms. In a more conservative analysis permitting an evaluation of the time ordering of disability increases and onset of depression, we found an even stronger relationship between disability and depression. Among individuals not depressed at T1 or T2, a T1 to T2 disability increase significantly predicted new T3 depression. Individuals with a disability increase defined using mean VLA difficulty had a risk of new depression that was more

Table 3—*Association Between Disability and Depression at Time 1*

	Depression	No.	% VLAs Affected, mean (SD)	% VLAs Unable to Perform, mean (SD)	Mean VLA Difficulty, mean (SD)
All	No	293	23.5 (22.2)	1.7 (5.3)	0.31 (0.35)
	Yes	156	64.8 (31.4)	12.8 (17.1)	1.12 (0.70)
	P Value[a]		< .0001	< .0001	< .0001
COPD	No	140	28.7 (23.2)	2.8 (7.1)	0.40 (0.40)
	Yes	102	69.5 (27.6)	14.5 (17.1)	1.23 (0.66)
	P Value		< .0001	< .0001	< .0001
Chronic bronchitis	No	153	18.7 (20.2)	0.7 (2.3)	0.22 (0.26)
	Yes	54	55.8 (36.1)	9.5 (16.9)	0.90 (0.72)
	P Value		< .0001	.0003	< .0001

Depression defined as high levels of depressive symptoms, S-GDS score ≥ 4. VLA = valued life activities. See Table 1 for expansion of other abbreviations.
[a]*P* value from *t* tests comparing disability scores between individuals with and without depression.

than triple the risk associated with having no disability increase. Individuals with disability increases as defined by the proportion of VLAs they were unable to perform had a risk of new depression 17 times higher than for individuals without such an increase in disability. Some research has shown that depressed individuals tend to rate themselves as more disabled than others with the same degree of impairment but without depression.[51] A strength of our study is that we minimized the impact of this effect in our longitudinal analysis by excluding individuals who were depressed at T1 or T2 when the disability assessments were made.

In addition to its burden on quality of life, depression is associated with poor self-care and medication adherence, continued smoking, and increased disease exacerbations, each of which may accelerate declines in health, as well as with increases in health care use and mortality.[5,30,52-57] In other populations, depression is associated with some of the same poor health outcomes,[58-61] making it likely that the relationship between depression and COPD is not unique to COPD. Nonetheless, the high prevalence of depression in COPD makes this association particularly noteworthy.

Table 4—*Prevalence of Increases in Disability from Time 1 to Time 2*

Disability Measure	Total Cohort	COPD	Chronic Bronchitis
% VLAs affected			
% (No.) with increase	18.6 (71)	21.5 (43)	15.5 (28)
Odds of increase in disability, OR (95% CI)[a]			
Unadjusted	…	1.5 (0.9, 2.5)	…
Adjusted[b]	…	1.3 (0.7, 2.4)	…
% VLAs unable to perform			
% (No.) with increase	8.1 (31)	12.0 (24)	3.9 (7)
Odds of increase in disability, OR (95% CI)[a]			
Unadjusted	…	3.4 (1.4, 8.1)	…
Adjusted[b]	…	1.9 (0.7, 5.4)	…
Mean VLA difficulty			
% (No.) with increase	16.3 (62)	19.5 (39)	12.7 (23)
Odds of increase in disability, OR (95% CI)[a]			
Unadjusted	…	1.7 (1.0, 2.9)	…
Adjusted[b]	…	1.3 (0.7, 2.6)	…

Increase in disability defined as having a 0.5 SD increase in disability scores between Time 1 and Time 2. See Tables 1, 2, and 3 for expansion of abbreviations.
[a]Reference for analysis is chronic bronchitis group.
[b]Adjusted for age, sex, race, education, smoking status, comorbidities, and COPD Severity Score.

There are potential limitations to this study. Our classification of depression was based on a depressive symptoms questionnaire. Even though the S-GDS yields a classification consistent with a diagnostic interview for 86% of respondents, there is still a possibility of misclassification. The criteria used to define increases in disability may not represent the critical values for increases. No studies have been performed to define minimal clinically important differences in VLA disability, but the one-half SD criterion that we used has been identified as a reasonable proxy. The airways cohort may somehow be unrepresentative of individuals with these conditions. However, because participants were recruited from the community rather than through an academic medical center or tertiary care center, the distribution of disease severity and other relevant characteristics may be more similar to the population of

In response to the question posed by the American College of Chest Physicians Panel on Anxiety and Depression regarding early predictors of depression in COPD that may lead to development of preventive strategies, our results suggest that one potential answer lies with assisting individuals with COPD in maintaining VLAs, or perhaps recognizing increasing disability as a cue for psychological intervention. Such intervention may serve to prevent the onset of psychological distress and perhaps subsequent depressive disorders that appear to be common in COPD. Supporting this hypothesis is a study reporting improvements in psychological status following pulmonary rehabilitation in which functioning was improved.[62]

Table 5—*Likelihood of Depression at Time 3 Following an Increase in Disability Between Time 1 and Time 2*

	Total Sample (n = 338)				Excluding Participants Who Were Depressed at Time 1 or Time 2 (n = 297)			
	T3 Depression % (No.)		Likelihood of T3 Depression OR (95% CI)		T3 Depression % (No.)		Likelihood of T3 Depression OR (95% CI)	
Disability measure	↑ Disability	No ↑ Disability	Unadjusted	Adjusted[a]	↑ Disability	No ↑ Disability	Unadjusted	Adjusted[a]
% VLAs affected	50.9 (30)	28.3 (79)	2.6 (1.5, 4.6)	3.6 (1.7, 7.7)	17.4 (8)	10.4 (17)	2.2 (0.8, 6.1)	2.7 (0.9, 8.1)
% VLAs unable to perform	79.2 (19)	28.7 (90)	9.5 (3.4, 26.1)	6.1 (1.7, 21.8)	33.3 (6)	10.0 (19)	17.3 (3.0, 100.4)	13.4 (2.0, 91.4)
VLA difficulty	56.0 (28)	28.1 (81)	3.3 (1.8, 6.0)	3.6 (1.7, 8.0)	15.8 (6)	11.1 (19)	3.3 (1.2, 9.5)	3.9 (1.3, 11.8)

Depression defined as high levels of depressive symptoms, S-GDS score ≥ 4. OR = odds ratio. T3 = time 3. See Table 3 for expansion of other abbreviations.

[a]Total sample analyses adjusted for age, sex, race, education, smoking status, comorbidities, COPD severity score, baseline S-GDS score, and baseline value of disability measure. Disease subgroups adjusted for age, sex, COPD Severity Score, and baseline value of disability measure.

individuals with these conditions. Because we did not have results of pulmonary function testing and medical records and relied on self-reports of physicians' diagnoses, some individuals may have been classified into the wrong condition group. Such misclassification would tend to attenuate differences among the groups, however, biasing our results toward null findings.

An incidental finding was that individuals who were depressed were more likely to be lost to follow-up, which is not uncommon in longitudinal studies.[47,63] Such a bias through attrition has important implications for future longitudinal studies, particularly those dealing with psychological well-being and distress. Clearly, it will be difficult to conduct follow-up studies of individuals who are depressed, but with foreknowledge of this potential problem, researchers can put extra safeguards in place to try to maintain follow-up with such individuals or can use selected data management or imputational approaches. Although this differential loss to follow-up may have affected our results, the effect would most likely be to dampen the observed impact of increased disability because some of those with increased disability who became depressed may not have completed the T3 interview.

In summary, over 3 years, we found that significant portions of our cohort met the criterion for at least mild depression, and 8% to 19% exhibited disability increases over 2 years. Disability increases were strongly predictive of later depressive symptoms, even among individuals who were not depressed initially. Our results provide robust evidence that increases in VLA disability precede and play an important role in the onset of depressive symptoms in individuals with COPD. Future research should identify factors associated with the development and progression of VLA disability, as well as factors that may protect against or ameliorate such disability. The latter is especially important, because these may represent potential targets for intervention.

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