Published in final edited form as:

Int J Geriatr Psychiatry. 2010 October ; 25(10): 1080–1084. doi:10.1002/gps.2477.

Shortness of breath as a predictor of depressive symptoms in a community sample of older adults

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Abstract

Objectives—Physical symptoms are known to be associated with late life depression both cross-sectionally and over time. We attempted to determine if self-reported shortness of breath (SoB) is associated with depressive symptoms at long-term (3-year) follow-up in a community sample of older (65+) adults.

Methods—A sample of 2926 elderly subjects from the Duke Established Populations for Epidemiologic Studies of the Elderly (EPESE) were evaluated at baseline and at 3-year follow-up. Depressive symptoms were assessed by a modified version of the Center for Epidemiologic Studies—Depression Scale (CES-D) and SoB was assessed by a three-item scale administered at baseline. The analyses were controlled for factors known to be associated with depressive symptoms and SoB. Both bivariate and multivariate analyses were performed.

Results—Eighty-three percent of subjects who experienced SoB survived for three years. Within the analysis sample of those participating at follow-up, 36 percent experienced SoB at baseline. In bivariate analyses, SoB, older age, female sex, history of a heart attack, higher body mass index (BMI), depressive symptoms at baseline, cognitive impairment, and functional impairment were associated with follow-up depressive symptoms. When controlled variables were included in a linear regression model, SoB was a significant predictor of depressive symptoms at follow-up ($p < 0.0001$) as well as baseline depressive symptoms, sex, BMI, and functional status. No two-way interaction terms with SoB were significant.

Conclusions—SoB is a significant predictor of depressive symptoms at 3-year follow-up. Given that SoB is a symptom that is responsive to therapeutic intervention, active intervention to relieve the symptom when identified could reduce the incidence of depressive symptoms.

Keywords

old age; epidemiology; depression; shortness of breath; longitudinal study

Introduction

Many physical disorders, such as cardiac disease, diabetes, and various cancers, can lead to depression in older adults (Romanelli *et al.*, 2002; Lyles, 2001). Functional status can also have an impact on depression (Bruce, 2001; Zeiss *et al.*, 1996). Yet we have little data on

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Conflict of interest

None known.

how specific physical symptoms (those very presentations most often seen in the primary care physician's office) contribute to depression.

One of the most common symptoms among older adults is shortness of breath (SoB). In the Duke Established Populations for Epidemiologic Studies of the Elderly (EPESE), over one-third of subjects reported SoB that required them to stop and rest (Cornoni-Huntley *et al.*, 1990). Chronic obstructive pulmonary disease (COPD; the most common cause of SoB in the elderly—about 50% with COPD report SoB) is associated with a number of adverse outcomes (Walke *et al.*, 2007) including physical discomfort, fatigue, problems with appetite, and anxiety in this study. All of these symptoms may contribute to depression.

In a study of over 1000 outpatients, complaints that separate depressed from non-depressed patients included sleep disturbance, multiple physical complaints, non-specific musculoskeletal complaints, back pain, SoB, and vaguely stated complaints (Gerber *et al.*, 1992). In another study of depressive symptoms in elderly outpatients with stable yet disabling COPD, 46% were rated as clinically depressed compared to 11% of subjects with normal lung function (Yohannes *et al.*, 1998). However, spirometry results and exercise tolerance (6-min walk) did not predict the depression rating. The symptom of SoB, not the actual lung function, appears to be the important correlate with depression. In yet another study ($n = 20\,296$), COPD comorbid with cardiovascular disease, diabetes, and hypertension had a higher risk of hospitalization and mortality than those without. Of interest, subjects with symptoms of COPD but with normal lung function had as high a risk of cardiovascular disease as those with significant impairment of lung function (Dyer *et al.*, 1999). These studies suggest that symptoms of COPD, regardless of the underlying pathology, appear to be important predictors of health outcomes.

In a study of older adults, some with asthma and some without, quality of life was found to be impaired in elderly with asthma, including those with demonstrable airway variability, a symptom which can be relieved with therapy (Chavannes *et al.*, 2005). A study of 24 patients with severe COPD (Paz-Diaz *et al.*, 2007) assigned 10 to pulmonary rehab and 14 to a control group. The rehab program included disease education, energy conservation techniques, relaxation, and exercise. After pulmonary rehab, there was a significant improvement in the severity of depression compared to controls. Dyspnea was significantly better. These studies suggest that the symptoms of SoB can be relieved with aggressive treatment.

In a study of 147 primary care patients, female gender, body mass index (BMI), and dyspnea were associated with depressive symptoms. Lung function, smoking behavior, age, and comorbidity were not associated (Mannino *et al.*, 2008). Some health problems or health behaviors are known to be associated with both difficulty breathing and depression. Smoking clearly is the major risk factor for COPD and is associated with depression (Salive and Blazer, 1993). Myocardial infarction, a frequent precursor to congestive heart failure, is also known to increase the risk for depression (Frasure-Smith *et al.*, 1993).

We, therefore, explored the longitudinal association between SoB and depressive symptoms. We specifically asked the questions, "In a community sample of older adults, does SoB predict an increase in depressive symptoms 3 years later in controlled analyses?" and "Does shortness of breath interact with other risks for depressive symptoms synergistically?" These questions are important because older adults experience a number of chronic symptoms. Some can be potentially alleviated over time with aggressive medical therapy and others cannot. SoB is a symptom which potentially can be alleviated in older adults through aggressive therapy.

Methods

Participants

Data were drawn from the Duke EPESE project, a multi-center epidemiologic investigation of the physical, psychological, and social functioning of community-dwelling adults 65 years and older (65–105; Cornoni-Huntley *et al.*, 1990). The Duke sample was comprised of residents selected from five contiguous counties in North Carolina. The current study focuses on data from Wave 1 ($n = 4162$, 1986–1987) and Wave 2 ($n = 3314$, 1989–1990). The sampling design strategy has been reported in detail elsewhere (Cornoni-Huntley *et al.*, 1990). To summarize: data were collected through in-person interviews. Participants were administered a questionnaire that included detailed information about demographics, psychological, physical, social, and cognitive functioning. The baseline study and all follow-up studies were approved by the Duke Institutional Review Board (IRB) and are approved each year for secondary data analyses. We report results from the analysis sample, which includes all subjects who had data for all independent variables at baseline and depressive symptoms at 3-year follow-up ($n = 2926$). Non-response on the depression items contributes to much of the missing data which eliminated subjects from the analysis sample.

Shortness of breath

The baseline questionnaire only included three questions assessing SoB: (1) Do you get SoB that requires you to stop and rest? (yes/no); (2) Do you get SoB when you are lying down? (yes/no); and (3) Have you ever had attacks of SoB with wheezing? (yes/no). We realize that the wheezing question is a lifetime question whereas the other two are current questions. Nevertheless, the intercorrelation of the items is strong as noted by the coefficient α reported below. All three variables are correlated with one another at a level of 0.8 or better. In addition, only 82 participants reported wheezing only. Frequencies for each variable are presented in Table 1. We constructed a scale in which we assigned a score of “1” to each of the questions if answered “no” and a score of “2” if the question was answered “yes. This produced a range of scores from 3 to 6 (weighted frequencies for each score were 3 = 63.2%; 4 = 24.1%; 5 = 9.2%; and 6 = 3.5%). The coefficient α for the scale is 0.61, quite good for a three-item scale.

Depressive symptoms

A modified Center for Epidemiologic Studies—Depression Scale (CES-D) scale (Radloff, 1977) was administered at Wave 1 (1986; coefficient $\alpha = 0.82$; Blazer *et al.*, 1991). For ease of administration, a dichotomous response scale was used for each item, coded: 0 ‘No,’ 1 ‘Yes’. Responses across the 20 items were summed to create a CES-D scale score (range 0–20). Higher scores indicate more depressive symptoms. A score of 9+ on this modified version is equivalent to a score of 16+ on the usual CES-D (in this sample about 9% of subjects scored 9+ on the CES-D). Baseline and 3-year follow-up scores on the modified CES-D scale are presented in Table 1. Both baseline and follow-up CES-D scores were entered as continuous variables in the regression equations.

Control variables

We controlled for several variables that have been found to be associated with depressive symptoms and SoB including demographic variables (age, race, sex).

Cognitive functioning—The 10-item short portable mental status questionnaire (Short Portable Mental Status Questionnaire; Pfeiffer, 1975) was used to measure global cognition at Wave 1. Items assessed orientation and knowledge such as the date, current president, and simple arithmetic. In the current study, participants’ errors were summed across items to

form a continuous scale (0–10 errors), with higher scores indicating more difficulty with cognitive functioning. As suggested by the original scoring, if subjects did not answer three or more questions correctly, they were considered to be impaired.

Smoking status—Subjects were asked, “Do you smoke cigarettes regularly now?” If they answered “yes” they were considered a current smoker. The frequency of current smokers is presented in Table 1. The variable was entered as a dichotomous variable in the regression equations.

History of myocardial infarction—Subjects were asked, “Has a doctor ever told you that you had a heart attack, or coronary, or myocardial infarction, or coronary thrombosis, or coronary occlusion?” The frequency of subjects who answered yes or maybe is presented in Table 1. The variable was entered as a dichotomous variable (no vs. yes/maybe) in the regression equations.

Physical functioning—At baseline, three items from the Rosow–Breslau functional health scale (Rosow and Breslau *et al.*, 1966) were used to assess physical functioning. Items involved unaided ability to do heavy housework, walk up and down stairs, and walk one and a half mile (coefficient $\alpha = 0.79$). The frequency of some impairment is presented in Table 1. The variable was entered as a scale of 0–3 into the regression equations.

Body mass index—Subjects were asked at baseline to estimate their height and weight. From these estimates, we calculated the BMI. The mean and standard deviation are presented in Table 1. The data were entered into the regression analyses as a continuous variable.

Data analytic strategy

Initial analyses were conducted to describe the demographics of the participants, as well as the relevant variables included in the subsequent regression analyses. Bivariate regression analyses were used to test the significance for the independent and each of the control variables when follow-up depression scores were regressed on these variables. All p values reflect two-tailed tests. Linear regression analyses were conducted in which we examined the main effect of SoB on depressive symptoms at the 3-year follow-up controlling for depression at baseline in addition to controlling for variables associated with depressive symptoms and SoB listed above.

Next, we developed two-way interaction terms for SoB with each of the control variables including the non-significant variables. These interaction terms were entered as a group and then backed out of the regression analyses one at a time if they were not significant. Only two-way interactions were considered. No interaction terms were significant. Then we performed a backward elimination, maintaining all control variables in the model whose significance was $p < 0.10$. We, therefore, present only the main effects model. SAS 9.1 (Cary, NC) was used for the analyses. Data were weighted to adjust for the oversample of African Americans and non-response and down-weighted for significance testing.

Results

In bivariate analyses, SoB is correlated with depressive symptoms at baseline (0.33, $p < 0.001$) and associated with mortality at 3-year follow-up ($p < 0.001$) as is expected. Yet 83% of the baseline sample who reported some SoB remained alive at the second in-person follow-up (and 79% of the subjects who answered yes to all three items on the scale remained alive at follow-up). The unweighted frequency and weighted percentages for

categorical variables and the weighted mean and standard deviation for continuous variables are presented in Table 1. As can be seen, the three items making up the SoB composite variable are relatively frequent complaints. In addition, two risk factors for SoB and depression—current smoking and a history of myocardial infarct—were commonly reported by the sample. All control variables in weighted bivariate analyses predicting the CES-D score at the second in-person interview were significant at the $p < 0.01$ level except current smoker ($p < 0.17$) and race ($p < 0.02$).

In Table 2, we present the results of regressing depressive symptoms at 3-year follow-up upon SoB controlling for the variables retained through backward elimination. As can be seen, baseline SoB is a highly significant predictor of depression at follow-up, along with female sex, baseline depressive symptoms, functional status, and higher BMI.

Conclusions

SoB, in controlled analyses of a community sample of older adults, is a significant predictor of depressive symptoms 3 years after being assessed even when baseline depressive symptoms are controlled. We have assumed that self-reported SoB is a chronic symptom, which it usually is. The vast majority of subjects with SoB do survive to the follow-up, and SoB is significantly and independently associated with follow-up depressive symptoms even when baseline depressive symptoms are controlled. Therefore, the chronic symptoms of SoB may be a long-term predictor of depressive symptoms independent of other associated risks for depressive symptoms. No significant interaction was found between functional status and SoB in predicting follow-up depressive symptoms.

There are some limitations in this study. All the assessments were self-reported, including BMI (self-reported height and weight). Measures were obtained only at two points in time (and SoB was only assessed at the baseline interview). We experienced the expected attrition from a longitudinal study, especially in the regression models which eliminated all subjects who exhibited missing data on any of the variables analyzed. There is a potential for some selection bias in that SoB is associated with mortality in bivariate analyses at 3-year follow-up. Yet 83% of the subjects who reported some SoB did survive for 3 years. Despite these limitations, however, we believe these results provide evidence for the importance of SoB as a symptom that should be considered when evaluating older adults for risk of depressive symptoms in the future.

SoB (along with weight loss) is amenable to primary (before it ever begins by, for example, abstinence from smoking), secondary (early intervention), and tertiary prevention (oxygen therapy, bronchodilators, control of secretions). In addition, symptomatic relief from SoB is possible, except for the most severe cases.

Treating the primary cause of depressive symptoms in the medically ill is as important as treating the depressive symptoms themselves. SoB is not only a risk for depressive symptoms in older adults, it is a risk that is amenable to intervention. SoB should not be ignored when evaluating older adults for many reasons, yet the prevention of depressive symptoms appears to be an additional reason to consider.

Acknowledgments

This research was supported in part by grant MH066380 from the National Institute of Mental Health.

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Table 1

Frequency and distribution of study variables in analysis sample. Unweighted frequencies and weighted means, and percentages ($n = 2926$)

Variable	Unweighted frequencies	Weighted means/percentages
Mean age (SD)		72.3 (5.8)
Sex		
Males	973	35.5%
Females	1953	64.5%
Race		
White and other	1324	64.7%
African American	1602	35.3%
Cognitive impairment		
Impaired	204	6.8%
Not impaired	2722	93.2%
Functional impairment		
1+ impairments	1230	38.9%
No impairments	1695	61.1%
Current smoker		
Yes	484	16.2%
No	2442	83.8%
History of myocardial infarction		
Yes	408	14.3%
No	2518	85.7%
Body mass index		25.8 (4.7)
Shortness of breath that requires rest		
Yes	1000	32.6%
No	1926	67.4%
Shortness of breath when lying down		
Yes	275	8.6%
No	2651	91.4%
Shortness of breath with wheezing		
Yes	367	11.7%
No	2559	88.3%
Baseline CES-D score (modified scale)		2.8 (3.3)
3-year follow-up CES-D score		2.5 (3.4)

Table 2

Depressive symptoms at 3-year follow-up regressed on shortness of breath with control variables. Weighted model using backward elimination^a. Adj. $R^2 = 0.2744$ ($n = 2926$)

Variable	Parameter estimate	Standard error	<i>p</i> value
Intercept	−1.588	0.452	0.0005
Sex	0.302	0.117	0.0098
Baseline CES-D	0.462	0.018	<0.0001
Shortness of breath	0.306	0.076	<0.0001
Functional status	0.354	0.060	<0.0001
Body mass index (BMI)	0.028	0.013	0.0276
History of heart attack	0.274	0.164	0.094

^aVariables removed in backward elimination were age, race, cognitive impairment, and current smoker.