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Associations of Asthma Control and Airway Obstruction with Performance of Activities of Daily Living Among Older Asthmatics

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Abstract

Background—Asthma's impact on functional limitations of older adults in the United States has not been fully described.

Design—Analyses were conducted with data from the Asthma Beliefs and Literacy in the Elderly (ABLE) study, a prospective cohort study of asthmatics aged 60 and older.

Setting—Patients were recruited from urban primary care and pulmonary specialty practices in New York City and Chicago between 2010 and 2012.

Participants—380 women and 72 men, mean age 67.5 years (SD 6.8 range 60–98), 40% Latino, 30% black were included in the study.

Measurements—Characteristics of patients with limitations in activities of daily living (ADLs) were compared to those without ADL limitations using the chi-square test. Generalized estimating

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Author Contributions:

Study design: Eric C. Woods, Michael S. Wolf, Juan P. Wisnivesky, Alex D. Federman

Data acquisition: Rachel O'Connor, Melissa Martynenko, Michael S. Wolf, Juan P. Wisnivesky, Alex D. Federman

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equations were used to model the relationships between poor asthma control (Asthma Control Questionnaire [ACQ] score of >1.5) and severity of airway obstruction (Forced Expiratory Volume in one second [FEV₁]) and number of limitations of ADLs.

Results—Patients with one or more ADL limitations were more likely to be female (90% vs. 81%, $P=0.02$), Latino (58% vs. 32%, $P<.001$), have less than a high school education (53% vs. 27%, $P<.001$), an income \$1350 per month (79% vs. 46%, $P<.001$) and be unmarried (78% vs. 64%, $P=0.003$). In the adjusted analysis, worse ACQ scores (odds ratio [OR] 1.6, 95% confidence interval [CI] 1.0–2.4 $P<0.05$) but not severity of airway obstruction (OR 1.1, 95% CI 0.6–1.9) was associated with greater ADL limitations.

Conclusion—Older adults reporting poor asthma control are more likely to have limitations in ADLs than those with controlled asthma, though one-time spirometry may not adequately identify those at risk for physical impairment from their asthma.

Keywords

Asthma control; older adults; activities of daily living

INTRODUCTION

Although asthma is often considered primarily a disease of younger people, 7–11% of older adults suffer from asthma as well [1, 2]. Older adults, however, experience a disproportionately greater asthma-related mortality [3–6] and morbidity [7, 8] due to a longer duration of the condition, [9] pulmonary changes associated with aging, [10, 11] reduced awareness of symptoms, [12] and diagnostic difficulties [13, 14]. Among adults, asthma impairs activities of daily living (ADLs) and reduces levels of activity [13]. According to national estimates, 6% of adults in the United States who had at least one attack in the previous year experienced activity limitation caused by asthma [5]. Restrictions in activity can negatively affect everyday life [14] and delaying the onset of these limitations in older patients with asthma may improve quality of life, physical fitness, and mental health while decreasing medical care usage [7, 15, 16–18].

Previous studies presented limited data on the activity limitations caused by asthma in older adults. Most of these studies compared activity limitations in older adult asthmatics to those without any asthma [13]. Moreover, these analyses often included some patients who did not have a physician's diagnosis of asthma and did not account for other patient characteristics, such as the number and type of chronic conditions that may also impair physical function. Large-scale studies specifically examining the relationship between asthma control and activity limitations have focused predominantly on work impairment [19] or other broadly-defined measures of disability among the general adult population [20] rather than specifically among older adults who are more likely to have worse asthma control.

In this study, we sought to characterize the limitations in activities of daily living among older adults with asthma. Additionally, we hypothesized that there would be an association between measures of asthma control and ADL limitation among older adults with asthma.

METHODS

Participants and Settings

Analyses were conducted with data from the Asthma Beliefs and Literacy in the Elderly (ABLE) study, a prospective cohort study of asthma in adults aged 60 years and older. Patients were recruited from urban primary care and pulmonary specialty practices in two tertiary academic medical centers and three federally qualified health centers in New York City and Chicago between December 2009 and November 2012. Patients who spoke English or Spanish and had a physician-made diagnosis of persistent asthma that was moderate or severe as defined by the National Heart, Lung and Blood Institute's Expert Panel on Asthma [21] were identified by review of the electronic clinic encounter database at each site and considered for inclusion. Individuals with a smoking history of 10 or more pack-years, a diagnosis of chronic obstructive pulmonary disease (COPD) or other chronic respiratory illnesses, a diagnosis of dementia, or uncorrectable visual impairment were excluded. Trained, bilingual research assistants recruited patients by telephone and conducted a brief screening assessment to determine final eligibility. Eligible patients provided in-person, written informed consent at the time of the baseline interview. Follow-up interviews were conducted in-person at 12 months following the baseline interview. The study was approved by the institutional review boards of the Icahn School of Medicine at Mount Sinai and the Feinberg School of Medicine of Northwestern University.

Performance of ADLs

The outcome of interest was ADL impairment, assessed by the Katz Activities of Daily Living (ADL) Scale [22]. The questionnaire asks participants to rate the level of difficulty in performing six basic ADLs (bathing or showering, dressing, eating, getting in or out of bed or chairs, walking, and using the toilet). Response options were "no difficulty," "a little difficulty," "some difficulty," "a lot of difficulty," and "unable to do." Subjects were considered to have an activity limitation when they reported "a lot of difficulty" or that they were "unable to do" one or more basic ADL [23–24]. An alternative exploratory definition of ADL limitation using limitations in two or more basic ADLs was tested as well.

Asthma Control

According to the National Heart, Lung, and Blood Institute, asthma control refers to the degree to which the manifestations of asthma are minimized and the goals of therapy are met [21]. The assessment of control is emphasized for monitoring and adjusting therapy. This is contrasted against asthma severity, which is the intrinsic intensity of the disease process emphasized when initiating therapy [21]. Current asthma control was assessed at the baseline and 12 month follow-up interviews using the Asthma Control Questionnaire (ACQ) [25], a measure of asthma control that has demonstrated validity, reliability, and sensitivity to change over time [26]. We used a five-item version that excludes two questions about β_2 -agonist use and FEV₁. This shortened version has shown high agreement with the original ACQ without loss of validity [27, 28]. The five items in this modified version measure the extent to which an individual has experienced asthma symptoms including disturbance of sleep, asthma immediately after waking, disruption of daily life activities, shortness of breath, and wheezing. Each item is scored on a seven-point scale from 0 (completely

controlled) to 6 (very poorly controlled). The average rating on the five items provides an overall score. Poor asthma control was defined as values greater than 1.5 [29].

Bronchial Obstruction

As another indicator of current asthma control, we measured the degree of bronchial airway obstruction using the measured FEV₁ compared to predicted forced expiratory volume at 1-second (FEV₁) at baseline [30]. FEV₁ measures the maximum volume of air forcibly expired in one second after full inspiration. This assessment was performed in the absence of bronchodilator use and in accordance with American Thoracic Society criteria [31] using a Midmark IQspiro Digital Spirometer (MidMark Diagnostics Group, Gardena, CA). We used FEV₁ less than 70% of predicted as an indicator of significant airway obstruction.

Participant Characteristics

We considered other variables that, based on previous research, might confound the association between asthma control and functional decline. These included demographic variables that have a known association with functional impairment: age [32], race/ethnicity [33], gender [33, 34], education [35], and income [36]. Additionally, we considered indicators of health status associated with disability: comorbid chronic illnesses (osteoarthritis, diabetes, and chronic heart failure) [37], depression [38, 39], cognitive impairment [40], and obesity [41, 42]. Depression was determined by a score of 10 or greater on the validated patient health questionnaire (PHQ-9) [43]. Cognitive impairment was defined as a Mini-Mental State Examination score less than one standard deviation below the age and education-adjusted normal value [44]. Obesity was defined as a body mass index of 35 or greater.

Finally, we considered social support, which may moderate the association between asthma control and physical functioning [39]. Social support was measured via two items. Patients were considered to have spousal support if they were married or lived with their partner. Additionally, we used the Lubben Social Network Scale (LSNS-6) to measure the strength of the individual's social network [45]. The scale is constructed from a set of three questions that evaluate kinship ties and three questions that evaluate non-kin ties. Scores range from 0 to 30. Individuals who scored less than 12 were identified as socially isolated [45].

Statistical Analysis

Differences at baseline in asthma control, demographics, social support, and measures of physical health between those with and without disability were examined using the chi-square test, t-test, and Wilcoxon rank sum test, as appropriate. We used generalized estimating equations to model the relationships between asthma control and disability and bronchial obstruction and disability at baseline and 12-months while controlling for sociodemographic and health status variables. First we entered demographic and social support variables. Then, to examine the impact that health conditions play, we added those variables to the model. Modeling was then repeated using a stricter definition of disability (2 limitations in ADLs). Finally, generalized estimating equations were used in an exploratory analysis to model the relationship between FEV₁ as a discrete variable with 4

levels and disability. All analyses were conducted in SAS version 9.3 (SAS institute, Cary, NC).

RESULTS

Sample Characteristics

We identified 1972 potentially eligible patients and successfully contacted 1506. Among these, 1025 agreed to undergo screening for the study, 502 were eligible and 452 completed the baseline interview.

The mean age of the study participants was 68.5 (6.8) years; 84% were female, 30% were non-Hispanic black, 40% were Hispanic, 35% had not completed high school, and 25% had a monthly household income less than or equal to \$750 per month (Table 1).

Overall, 31% of patients had one or more ADL limitation (Table 1). Compared to those with no limitations, those with ADL limitations were more likely to be female (90% vs. 81%, $p=.02$), Hispanic (58% vs. 32%, $p<.001$), have less than a high school education (53% vs. 27%, $p<.001$), and low income ($\leq \$750/\text{month}$, 36% vs. 20%, $p<.001$). They also had less social support as indicated by a lower likelihood of current marriage (22% vs. 36%, $p=.003$) and greater rates of social isolation (26% vs. 16%, $p=.02$). They also had poorer self-reported health (poor health, 97% vs. 69%, $p<.001$) and greater likelihood of having chronic diseases like congestive heart failure (23% vs 9%, $p<.001$), diabetes (47% vs 28%, $p<.001$), osteoarthritis (86% vs 62%, $p<.001$), and depression (39% vs 13%, $p<.001$). Finally, individuals with ≥ 1 ADL limitation were more likely to report an asthma-related hospitalization occurring in the prior 12 months (14% vs. 7%, $p=.03$).

Associations of Asthma Control and Airway Obstruction with ADL Limitations

Poor asthma control was reported by 44% of patients and 35% had $\text{FEV}_1 < 70\%$ (Table 2). Compared to patients with good asthma control, older adults with poor asthma control were more likely to report one ADL limitation (20% vs. 14%, $p<.001$), 2–3 ADL limitations (17% vs. 8%, $p<.001$), or ≥ 4 ADL limitations (7% vs. 0.4%, $p<.001$) (Table 2). Poor asthma control was associated with limitations in five of the six ADLs assessed; most notably, walking (38% vs. 19%, $p<.001$), transferring (18% vs. 7%, $p<.001$), and bathing (13% vs. 0.04%, $p<.001$) (Table 3). Eating was not impaired among those with poor asthma control.

Individuals with airway obstruction ($\text{FEV}_1 < 70\%$) demonstrated a non-significant trend of reporting one or more ADL limitations compared to those without obstruction (35% vs. 29%, $p=0.13$) (Table 2). A significant relationship was found between airway obstruction and two specific ADL limitations, bathing (10% vs. 3%, $p=.007$) and dressing (10% vs. 2%, $p<.001$) (Table 3).

Notably, there was a weak association between self-reported asthma control and FEV_1 , in both comparison of the continuous measures (ACQ score and FEV_1 , $r=-0.11$, $p=.01$) and the dichotomized measures ($\text{ACQ} > 1.5$ and $\text{FEV}_1 < 70\%$, $\text{kappa}=0.05$, $p=.08$).

Adjusted analyses showed that (Table 4) both sociodemographic factors and health status characteristics mitigated the association of asthma control with ADL limitations. Adjustment for age, gender, race, education, income, and social support measures reduced the association of asthma control from the unadjusted odds ratio (OR) 2.61, 95% confidence interval (CI) 1.79–3.80 to adjusted OR 1.97 (95% CI 1.28–3.03). With the addition of health status and cognition factors, the association was further diminished but remained statistically significant: OR 1.56 (95% CI 1.00–2.44). Notably, in the fully adjusted model, poor general health, a history of osteoarthritis, and current depression were also significantly associated with any ADL limitation.

The association between asthma control and ADL limitation was also statistically significant when the alternative definition of ADL limitation was used (≥2 ADL limitations; unadjusted OR: 4.20, 95% CI: 2.54–6.93), and remained significant after adjustment for age, gender, race, education, income, and social support measures (adjusted OR: 1.98, 95% CI 1.28–3.03). With the addition of health status and cognition factors to the model, the association also remained statistically significant (OR 1.56 [95% CI 1.00–2.44], $p=.05$).

In an exploratory analysis, we examined FEV₁ as a discrete variable with 4 levels: <60%, 61–70%, 71–80% and ≥80% of predicted. Only FEV₁ <60% was significantly associated with one or more ADL limitations (unadjusted OR 1.85, 95% CI 1.15–2.97, $p=.01$), though it was no longer significant in the fully adjusted model (OR 1.09, 95% CI 0.63–1.87) (Table 5).

DISCUSSION

Studies describing how asthma symptoms interfere with a patient's ability to function are uncommon, especially in the older adult population. In this study, we sought to examine the association between asthma control and limitations in ADLs in older adults in an outpatient clinical setting. We found that older adults with poor asthma control were nearly twice the odds to have ADL limitations as older adults with well-controlled asthma. Limitations were reported for bathing, dressing, walking, toileting, and transferring, but not for eating.

The findings of this study confirm and extend those of the small and methodologically limited body of work previously presented on this topic. Nejari reported that older adults with asthma were more likely to have limitations in instrumental ADLs (IADLs, e.g., telephone use, shopping, and cooking) compared to older adults without asthma but not for basic ADLs, though differences were significant in analysis of physical function assessed using a scale that included ability to perform heavy work, walk a specified distance, climb stairs, and participate in social activities [7]. The study, however, used no objective measures of asthma control or airway obstruction. Player and colleagues created a multi-domain scale for assessing functional impairment in adults with asthma, which included items that asked the respondents whether their asthma symptoms impaired their ability to do normal daily activities, leave their home, and get dressed, among others [46]. In their validation cohort, 60% of which were asthmatics over age 50, the overall scale score had a fair correlation with self-reported airway obstruction ($r=0.21$, $p<.01$). Like the prior study, Player and

colleagues' analyses did not adjust for important correlates of functional impairment in older adults. Another study had similar findings as well as similar methodological limitations [47].

In contrast to the aforementioned studies, ours was homogeneous with regard to older adults with asthma, used well validated self-reported and objective measures of asthma control and pulmonary function, a widely used measure of physical functioning appropriate for elderly populations, and involved analyses that appropriately adjusted for key confounders, including age, comorbidity, depression, and cognitive impairment. Thus our findings firmly establish an independent association of asthma control and physical impairment in older adults. Other research has suggested that poor asthma control in older adults is associated with medication non-adherence, competing demands for management of other chronic illnesses, environmental exposures, and reduced health literacy [48]. Additional research is working to identify whether there is any difference in asthma control based on phenotypic subsets with the ultimate goal of providing better-tailored therapies, although this is still a work in progress [49].

Unlike self-reported asthma control, we found no significant association between current airway obstruction ($FEV_1 < 70\%$) and ADL limitations, though a more stringent criterion for airway obstruction, $FEV_1 < 60\%$ was associated with overall ADL limitations in an unadjusted analysis. One explanation for this finding might be that FEV_1 was measured at a single time point and may not reflect average airway obstruction among older adults over the preceding weeks. Multiple FEV_1 measurements may be necessary to establish a reliable correlation between objectively measured airway obstruction, asthma symptoms, and physical function. Whether such a problem would be unique to older adults is unclear because the ACQ has not been validated against FEV_1 among elderly patients, and in our cohort there was a weak association between ACQ scores and FEV_1 , whereas in younger adults, ACQ scores have been shown to correlate strongly with FEV_1 ($r = -0.89$, $p < .001$) [50]. It is possible that measurement errors could explain this discrepancy, for example if older asthmatics attributed the breathing difficulties of comorbidities or deconditioning to asthma or vice versa [50], or made weak efforts or had poor technique during spirometry. However, spirometry in our study was performed in accordance with American Thoracic Society guidelines [31] and the flow-volume loop tracings for each patient were reviewed by the investigators for quality. Spirometry was repeated for inadequate tracings.

Limitations

We note some methodological limitations to this study. Due to the cross sectional nature of our analyses, we are unable to prove that asthma causes disability, though biological plausibility supports the assumption of a directional association. We used a single, well-validated measure of functional status but did not assess function in domains not captured in the ADL measure, including instrumental activities of daily living, caregiving, hobbies, and social activities.

Summary

Older adults reporting poor asthma control are more likely to have limitations in activities of daily living than those with controlled asthma, though one-time spirometry may not identify

those at greatest risk for physical impairment from their asthma. Physicians should routinely inquire about physical functioning in their older asthmatic patients, and may find reports of poor functioning as an indication that their asthma is inadequately controlled.

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Table 1

Patient Characteristics by Number of Limitations in Activities of Daily Living

	Total	Limitations in Activities of Daily Living		P
		None N=312, 69.0 %	1 N=140, 31.0	
Age in years, <i>mean (sd)</i>	68.5 (6.8)	67.5 (6.5)	67.7 (7.4)	.79
60–64 years, %	44.2	44.5	43.6	.37
65–69 years, %	24.0	22.3	28.9	
70 years, %	31.8	33.2	28.6	
Female, %	84.1	81.4	90.0	.02
Race, %				
White non-Hispanic/other	29.7	36.9	13.7	<.001
Black, non-Hispanic	30.4	31.4	28.1	
Hispanic	39.9	31.7	58.3	
Education, %				<.001
College graduate or higher	28.2	35.9	10.9	
Some college	19.8	21.8	15.2	
High school graduate or equivalent	17.3	15.7	21.0	
Some high school or less	34.7	26.6	52.9	
Monthly income, %				<.001
\$3001	20.7	27.5	5.2	
\$1351 – \$3000	23.9	27.5	15.7	
\$751 – \$1350	30.9	25.5	43.3	
\$750	24.6	19.6	35.8	
Married or living with partner, %	31.3	35.6	21.6	.003
Lubben scale				.02
Low risk of isolation	28.8	31.7	22.3	
Moderate or high risk of isolation	52.1	52.4	51.8	
Socially isolated	19.1	16.0	25.9	
General health, poor to good, %	77.6	68.8	97.1	<.001
Chronic conditions, %				
Congestive heart failure	13.1	8.7	22.9	<.001
Diabetes mellitus	33.9	28.0	47.1	<.001
Osteoarthritis	69.3	61.7	86.3	<.001
Depression, moderate-severe, %	20.9	13.1	38.8	<.001
Cognitive impairment, %	35.9	32.3	44.2	.02

	Total	Limitations in Activities of Daily Living		P
		None N=312, 69.0 %	1 N=140, 31.0	
Emergency department visit, past 12 months, %	23.5	21.0	29.0	.07
Hospital admission, past 12 months, %	9.4	7.4	13.8	.03

Table 2Limitations in Activities of Daily Living by Asthma Control and FEV₁

ADL Limitations	Total% (N = 452)	Asthma Control % (n)		FEV ₁ % (n)		P
		Good	Poor	70%	<70%	
0	69.0 (312)	77.7 (209)	56.3 (103)	71.3 (209)	64.8 (103)	
1	16.4 (74)	13.8 (37)	20.2 (37)	15.7 (46)	17.6 (28)	
2–3	11.7 (53)	8.2 (22)	16.9 (31)	12.3 (36)	10.7 (17)	0.002
4	2.9 (13)	0.4 (1)	6.6 (12)	0.7 (2)	6.9 (11)	

FEV₁ denotes forced expiratory volume in 1 second; ADL, activity of daily living; Good Asthma Control denotes an ACQ score <1.5; Poor Asthma Control denotes an ACQ score > 1.5.

Table 3
Association of Asthma Control and FEV₁ with 1 Limitation in Activities of Daily Living

Impairment	Overall	Asthma Control		P	FEV ₁		P
		Good	Poor		70% <	FEV ₁	
1 ADL Limitations, %	31.0	22.3	43.7	<.001	28.6	35.4	.13
Bathing, %	5.5	0.4	13.1	<.001	3.4	9.5	.007
Dressing, %	5.1	1.5	10.4	<.001	2.4	10.1	<.001
Toileting, %	5.8	3.4	9.3	.008	2.1	3.8	.27
Walking, %	26.4	18.7	37.7	<.001	4.4	8.2	.10
Transferring, %	11.3	7.1	17.5	<.001	24.9	29.1	.33
Eating, %	2.7	2.2	1.3	0.50	2.1	2.7	.28

FEV₁ denotes forced expiratory volume in 1 second; ADL, activity of daily living; Good Asthma Control denotes an ACQ score <1.5; Poor Asthma Control denotes an ACQ score > 1.5.

Table 4

Multivariate Associations of Poor Asthma Control with 1 Limitations in Activities of Daily Living

	1 Limitations in Activities of Daily Living		
	Model 1 Odds Ratio (95% CI)	Model 2 Odds Ratio (95% CI)	Model 3 Odds Ratio (95% CI)
Poor asthma control	2.61 (1.79–3.80) ***	1.97 (1.28–3.03) **	1.56 (1.00–2.44) *
Age, years			
60–64	-	Ref.	Ref.
65–74	-	1.17 (0.74–1.85)	0.99 (0.60–1.63)
75	-	0.87 (0.47–1.60)	0.72 (0.37–1.40)
Female	-	1.82 (0.94–3.53)	1.39 (0.65–2.96)
Race/Ethnicity			
White non-Hispanic/other	-	Ref.	Ref.
Black, non-Hispanic	-	1.66 (0.87–3.25)	1.28 (0.65–2.50)
Hispanic	-	2.48 (1.27–4.84) **	1.81 (0.93–3.51)
Education			
College graduate or higher	-	Ref.	Ref.
High school graduate or equivalent	-	1.72 (0.90–3.29)	2.27 (1.15–4.47) **
Some high school or less	-	1.70 (0.95–3.06)	1.59 (0.88–2.88)
Monthly income \$750	-	2.28 (1.33–3.92) **	1.77 (0.99–3.15)
Married or living with partner	-	0.92 (0.54–1.56)	1.05 (0.61–1.81)
Social isolation			
Low risk of isolation	-	Ref.	Ref.
Moderate to high risk	-	0.89 (0.54–1.47)	0.79 (0.47–1.34)
Socially isolated	-	1.06 (0.55–2.04)	0.86 (0.43–1.71)
General health, poor to good	-	-	4.06 (1.93–8.52) ***
Chronic conditions	-	-	
Congestive heart failure	-	-	1.36 (0.76–2.44)
Diabetes	-	-	1.16 (0.73–1.87)
Osteoarthritis	-	-	3.09 (1.71–5.60) ***
Depression, moderate-severe	-	-	2.32 (1.40–3.85) **
Cognitive impairment	-	-	1.33 (0.83–2.12)

Ref. denotes reference value

* P<.05,

**
P<.01,

P<.001

Model 1: Unadjusted model

Model 2: Adjusted for patient demographics and social support

Model 3: Adjusted for patient demographics, social support, and health status

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Table 5

Multivariate Associations of Airway Obstruction with 1 Limitations in Activities of Daily Living

	Model 1 Odds Ratio (95% CI)	Model 2 Odds Ratio (95% CI)	Model 3 Odds Ratio (95% CI)
FEV₁, % predicted			
81	Ref.	Ref.	Ref.
71–80	1.12 (0.63–1.99)	1.13 (0.58–2.23)	0.87 (0.44–1.72)
61–70	1.08 (0.63–1.87)	0.84 (0.46–1.52)	0.83 (0.42–1.64)
60	1.85 (1.15–2.97) *	1.21 (0.72–2.03)	1.09 (0.63–1.87)
Age, years			
60–64	-	Ref.	Ref.
65–74	-	1.09 (0.70–1.70)	0.93 (0.57–1.54)
75	-	0.74 (0.70–1.37)	0.66 (0.34–1.28)
Female	-	1.94 (0.99–3.79)	1.44 (0.67–3.09)
Race			
White non-Hispanic/other	-	Ref.	Ref.
Black, non-Hispanic	-	1.67 (0.88–3.22)	1.30 (0.66–2.55)
Hispanic	-	2.46 (1.28–4.75) **	1.81 (0.93–3.51)
Education			
College graduate or higher	-	Ref.	Ref.
High school graduate or equivalent	-	1.69 (0.90–3.15)	2.21 (1.13–4.32) *
Some high school or less	-	1.70 (0.94–3.06)	1.57 (0.87–2.84)
Monthly income \$750	-	2.46 (1.44–4.20) **	1.81 (1.01–3.24) *
Married or living with partner	-	0.86 (0.51–1.45)	1.02 (0.56–1.77)
Social isolation			
Low risk of isolation	-	Ref.	Ref.
Moderate to high risk	-	0.88 (0.54–1.45)	0.78 (0.46–1.32)
Socially isolated	-	1.09 (0.57–2.10)	0.88 (0.44–1.77)
General health, poor to good	-	-	4.53 (2.13–9.63) ***
Chronic conditions			
Congestive heart failure	-	-	1.37 (0.75–2.47)
Diabetes	-	-	1.10 (0.69–1.76)
Osteoarthritis	-	-	2.97 (1.64–5.36) ***
Depression, moderate-severe	-	-	2.58 (1.56–4.26) ***
Cognitive impairment	-	-	1.35 (0.84–2.15)

Ref. denotes reference value; FEV₁, forced expiratory volume in 1 second

*
P<.05,

**
P<.01,

P<.001

Model 1: Unadjusted model

Model 2: Adjusted for patient demographics and social support

Model 3: Adjusted for patient demographics, social support, and health status