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Comorbidity Burden and Depressive Symptoms among Older Adults with Asthma

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Abstract

Objective

Depression is associated with poor outcomes among older adults with asthma, and the presence of multiple comorbidities may magnify this relationship. We sought to determine the association of comorbidities with depressive symptoms among older adults with asthma.

Methods

Secondary analysis of data from a randomized controlled trial of older adults with poorly controlled asthma and comorbidities. Comorbidities were measured in two ways: 1) as a count of all the patient's chronic diseases, and 2) as a count of chronic illnesses with self-management intensive needs (diabetes, hypertension, congestive heart failure). Depressive symptoms were measured using the PROMIS SF8a scale. Multiple regression analyses tested the relationship between comorbidities and depressive symptoms, adjusting for sociodemographic factors.

Results

Overall, 25% of participants had moderate-severe levels of depressive symptoms, 87% had $\geq$ two comorbidities, and 41% had $\geq$ one comorbidity with self-management intensive needs. The count of all comorbidities was significantly associated with depressive symptoms ($F(8, 330) = 7.7, p < .0001, R^2 = .158$) in adjusted models, whereas the count of self-management intensive conditions was not significantly associated with depressive symptoms in adjusted analyses.

Conclusions

In older adults with asthma and multiple comorbidities, depressive symptoms increased with the overall count of comorbidities but not with the count of comorbidities with self-management intensive needs. Given the impact of depression on asthma outcomes for older adults, the

mechanisms by which comorbid illness contributes to depressive symptoms in older asthmatics warrants further evaluation.

Keywords: Comorbidity, depression, older adults, self-management, multimorbidity

Introduction

Older adults with asthma and depression are almost twice as likely to have poor asthma outcomes compared to those without depression, including more frequent asthma-related emergency room and urgent care visits, worse quality of life, and higher rates of asthma exacerbations and activity limitations (1). Compounding the challenges for self-care faced by older adults with asthma, more than half report at least one other chronic condition—or *comorbidity*—requiring varying degrees of self-management needs (2). Because the prevalence of depression is known to increase with each additional chronic illness (3), older adults with asthma and comorbidities may be at an increased risk for depressive symptoms. Thus, understanding the associations between comorbidities and depressive symptoms has important implications for asthma outcomes in older adults.

Research into multiple coexisting chronic illnesses commonly uses simple, unweighted counts of chronic conditions to assess comorbidities and their impact on health outcomes (4, 5). Additive counts are easy to apply in both research and clinical practice, and thus important to our understanding of how comorbid conditions can affect asthma outcomes. Similarly, there has been an increasing focus on categories or combinations of specific diseases that may better predict specific outcomes (4, 5). It is possible that not all conditions are created equal in relation to certain health outcomes, be it depressive symptoms or mortality—thus, exploring specific combinations of comorbidities in relation to depressive symptoms may have value beyond simple additive models of any comorbidity. Comorbidities with intensive self-management needs may be especially demanding for older adults with asthma. Chronic conditions with self-management intensive needs may require medication adherence, self-monitoring, attending medical visits, and implementing and maintaining changes to diet and physical activity (6), creating significant demands on older adults in addition to the management of their asthma. Therefore, we sought to test whether a greater number of comorbidities, in addition to specific comorbidities with intensive self-management needs, was associated with depressive symptoms among older adults with asthma. We hypothesized that a greater number of comorbidities would be associated with higher depressive symptoms. Additionally, we hypothesized that comorbidities with intensive self-management needs would be associated with greater depressive symptoms.

Method

Participants

Data for these analyses were collected during the baseline interview of the Supporting Asthma Self-Management Behaviors in older Adults (SAMBA) study, a randomized clinical trial of adults ages ≥ 60 years with persistent, uncontrolled asthma living in New York City. Full details have been described elsewhere (7). In brief, participants were identified from the electronic health records at an academic medical center and a federally qualified health center between February 2014 and December 2017, if they reported no other chronic pulmonary disease, a smoking history < 15 pack-years, were able to self-manage their medications (without assistance of a caregiver) and spoke English or Spanish. Interviews were administered by bilingual research assistants. Informed consent was obtained from all individual participants included in the study. The study protocol was approved by the institutional review boards of all participating institutions.

Measures

Diagnoses

Information regarding physician diagnosis of asthma and other comorbidities were obtained by self-report (conditions listed in Table 1). Presence of medical conditions were examined using participants' responses to the question "Has a doctor ever told you that you had [health condition]?", as assessed in the Health and Retirement Survey (8) and the National Health Interview Survey (9).

Comorbidities

Two separate measurements of comorbidities were examined. First, a simple count of all comorbidities reported by the patient. Second, a count of comorbidities with self-management intensive needs (diabetes, hypertension, chronic heart failure) as identified in prior publications, here indicated as comorbidities with self-management intensive needs (10). These conditions were selected following Peek et al. (10) due to their requirement for frequent and comprehensive, guideline recommended self-management strategies (e.g., asthma action plans, daily weights, self-glucose monitoring, polypharmacy, diet and physical activity regimens). This approach has been used in studies that explored disease classifications based on high treatment requirements for patients (11, 12).

Depressive symptoms

The Patient-Reported Outcome Measurement Information System Short Form version 8a (PROMIS SF 8a) (13) was used as a continuous variable to measure depressive symptoms. Higher scores indicate more depressive symptoms (standardized score range, 38.2-81.3). The PROMIS SF 8a assesses feelings of worthlessness, helplessness, depressed mood, hopelessness, and anhedonia. By excluding the somatic symptoms of depression (insomnia, fatigue, changes in appetite/weight), the PROMIS SF 8a reduces possible confounding effects of physical illness.

Asthma control

Total score in the Asthma Control Test questionnaire (ACT) (14) was used as a continuous variable to measure asthma control. Lower scores indicate poorer asthma control, with possible scores ranging from 5 to 25.

Sociodemographic measures

Age, gender, race, ethnicity and education were assessed using items adapted from the National Health Interview Survey (NHIS) (15).

Data Analysis

Univariate associations of independent variables with depressive symptoms were assessed using the Kruskal-Wallis and Wilcoxon Rank Sum tests and Spearman's correlations, as appropriate. Multiple regression analysis was used to test the relationship between comorbidities and depressive symptoms. Model 1 evaluated comorbidities with self-management intensive needs (count of comorbidities including diabetes, hypertension, chronic heart failure) and its association with depressive symptoms. Model 2 evaluated a simple count of comorbidities (overall count of chronic illnesses) to predict depressive symptoms. Models were adjusted for sociodemographic factors with

$p < .05$ in univariate tests of association with depressive symptoms, as well as for factors found to be significantly related to depressive symptoms in prior research (16-21). All analyses were performed using two-tailed tests with significance set at $p < .05$ in SAS 9.4 (SAS Institute, Cary NC). Power to detect effects for our hypothesis was examined using GPower for multiple regression $\alpha = 0.05$ (Confidence Level = 95%) and $\beta = 0.20$ (Power = 80%). A sample of 114 would have been needed to allow for power to detect an adjusted, standardized regression coefficient as low as 0.10 (small effect size).

Results

Participants ($n = 389$) were on average 67.6 years old ($SD = 7.4$), and mostly female (85%). The sample was highly diverse in terms of race and ethnicity: 39% identified as Black or African American; and 56% of participants identified as Hispanic or Latino, with the most common heritage or ancestry being Puerto Rican (60%) and Dominican (25%). Most participants had achieved a high school education or less (63%) and had a monthly income $< \$1,350/\text{month}$ (67%). A quarter of participants (25%) had probable moderate to severe depression based on validated cut-off scores (22), and a mean T score of 52.14 ($SD = 10.7$) on the PROMIS SF 8a for the sample as a whole. Most participants (87%) had two or more comorbidities, with the average number of comorbidities being 5.3 ($SD = 2.3$; range 0 – 12). Among those with comorbidities with self-management intensive needs, 41%, 32% and 5% had one, two or three diseases with self-management intensive needs, respectively. For full participant characteristics, see Table 1.

In univariate analyses (Table 2), depressive symptoms were significantly associated with ethnicity ($\chi^2 (1, n = 382) = 18.82, p < .0001$), income ($\chi^2 (3, n = 340) = 13.2, p < .01$), having completed the study interview in Spanish ($\chi^2 (1, n = 382) = 19.20, p < .0001$), asthma control ($r_s = -0.22, p < .0001$); and the presence of high cholesterol ($\chi^2 (1, n = 382) = 8.97, p < .01$), anxiety ($\chi^2 (1, n = 382) = 74.9, p < .0001$), osteoporosis ($\chi^2 (1, n = 382) = 4.39, p = .04$), arthritis ($\chi^2 (1, n = 382) = 12.38, p < .001$), and diabetes ($\chi^2 (1, n = 382) = 7.79, p = .005$).

The relationship of comorbidities and depressive symptoms

Comorbidities with self-management intensive needs and the count of any comorbidity (Table 2) were both associated with depressive symptoms in univariate analyses (comorbidities with self-management intensive needs: $r_s = 0.12, p = 0.02$; comorbidity count: $r_s = 0.25, p < .0001$).

For model 1, hierarchical regression models were used entering all covariates in step 1 and adding the comorbidity variable in step 2 in order to evaluate its contribution to the model. In the final model, asthma control was the only variable significantly associated with depressive symptoms ($t = -4.30, p < .001$). Contrary to our hypothesis, the count of comorbidities with self-management intensive needs was not significantly associated with depressive symptoms after adjusting for race, ethnicity, income, gender, education, language of interview and asthma control (See Table 3). The R^2 change due to the addition of comorbidities with self-management intensive needs to the model was .003, evidence that the addition of this comorbidity variable did not significantly improve the prediction of the model (F change (1,330) = .988, $p = .321$).

For model 2, hierarchical regression models were used entering all covariates in step 1 and adding the comorbidity variable in step 2 in order to evaluate its contribution to the model. In the final model a statistically significant association was found between comorbidity count (any comorbidity) and depressive symptoms ($t = 4.34, p < .001$), such that depressive symptoms increased by 1.09 units for each additional comorbidity after adjusting for race, ethnicity, income, gender, education, language of interview and asthma control. The R^2 change due to the addition of

comorbidity count to the model was .048, evidence that the addition of this comorbidity variable significantly improved the prediction of the model (F change (1,330) = 18.81, p = <.001). Income (t = -2.21, p = .028) and asthma control (t = -3.83, p < .001) were also significantly associated with depressive symptoms in the final model.

Discussion

We found that the additive model of any comorbidity was significantly associated with depressive symptoms among older adults with asthma in adjusted models, which corroborates previous observations of the co-occurrence of multiple chronic illnesses and depressive symptoms (3). Comorbidities with self-management intensive needs were significantly associated with depressive symptoms in univariate analyses. However, contrary to our hypothesis, this association did not remain significant in adjusted analyses.

While comorbidities with intensive self-management needs may be especially demanding for older adults with asthma, this was not associated with depressive symptoms in our study. Our design may have hindered us from finding support for this hypothesis in two ways. Because all participants had uncontrolled asthma, which is a self-management intensive disease, we may have been unable to find a relationship between comorbidities with self-management intensive needs and depressive symptoms due to ceiling effects: it is possible that among patients managing one condition with intensive self-management needs, depressive symptoms do not significantly worsen from adding a second condition with self-management intensive needs. Future studies should explore the possibility of ceiling effects in samples of individuals with multiple conditions with self-management intensive needs. It is also possible that our null findings in terms of comorbidities with intensive self-management needs may be due to using diagnoses instead of measuring the perceived burden of managing those comorbidities. Prior models of depression and multimorbidity (3) have suggested that diseases high in perceived treatment burden may lead to rumination on negative aspects of one's health status and, ultimately, distress. In the case of comorbidities with self-management intensive needs, perceived inability to perform all self-management tasks may lead to rumination on negative aspects of health and therefore distress (23). Thus, the compounding that takes place when older adults with asthma—a disease with intensive self-management needs—additionally manage several co-occurring conditions may leave patients at higher risk for depression due to the increase in self-management tasks. However, this was not supported in our sample. While we measured comorbidities with intensive self-management needs according to their requirement for frequent and comprehensive, guideline recommended self-management strategies, future research should consider recently developed self-reported treatment burden scales (24-26) that measure the subjective impact of multiple domains (e.g. health monitoring, physical and mental toll/exhaustion, medical appointments, interpersonal challenges) across illnesses instead.

Our findings that an additive model of comorbidities was associated with greater depressive symptoms among older adults with asthma has significant implications for researchers and clinicians working with this population. Additive models are easy to use—especially in clinical settings—and the presence of comorbidities should prompt clinicians to assess depressive symptoms among older adults with asthma. While we did not find support for comorbidities with self-management intensive needs in relation to depressive symptoms, there may still be value in future research efforts aimed at understanding specific patterns of comorbidities that are relevant to mental health and asthma outcomes. Treatment burden warrants further examination as it considers individuals' perceptions of the workload that comes with being a patient, and has important clinical implications in a context in which treatment guidelines are disease-specific instead of patient-centered, which can strain patients' capacity as suggested by the Cumulative Complexity Model (27). The relationship between comorbidities and depressive symptoms among older adults with asthma needs further examination

to identify intervention targets that can ameliorate the negative effects of both comorbidities and depressive symptoms on asthma outcomes.

Our findings must be interpreted in the context of several limitations. First, we acknowledge that the relationship between depressive symptoms and comorbidities is likely to be bidirectional, with depressive symptoms affecting health behaviors which could contribute to the development of chronic illness and worsen comorbidities (3)—longitudinal studies are needed to clarify directionality. Nonetheless, while the relationship between asthma comorbidities and depressive symptoms is likely bidirectional, a meta-analysis on the incidence of depression among older adults found that individuals with chronic diseases had a higher incidence of depression than those without chronic diseases ($RR = 1.53$, 95% CI : 1.2-1.97) (28), which underlines the importance of comorbidities as a risk factor for depressive symptoms in this population. We were not able to explore the specific contributions of anxiety in the relationship between comorbidities and depressive symptoms as we did not administer an anxiety measure. Given findings of high rates of comorbid depressive and anxiety disorders—as well as generalized anxiety disorder predicting onset and persistence of major depressive episodes over time (29)—, future studies should explore the specific contributions of anxiety to asthma comorbidities. While we did not detect any effect of age or gender on depressive symptoms, our sample was largely female (85%) and composed of young-old adults (69%). It is possible that the relationship between comorbidities and depressive symptoms differ among samples of older adults with asthma comprised of a larger number of male and older adults above the age of 70 years old. Chronic pain and symptom burden may be unexplored factors associated with both comorbidities with self-management intensive needs and depression (30); therefore, future studies should consider chronic pain and symptom burden, as well as physiological pathways such as inflammation that may moderate the relationship between comorbidities and depressive symptoms due to the stress associated with managing comorbidities with a varying range of self-management needs. Finally, we did not assess whether patients were receiving psychotherapy or pharmacological treatment for depression—which could have reduced the strength of associations by reducing the severity of depressive symptoms. However, based on the levels of depressive symptoms in this sample, this is unlikely to fully explain the null finding of an association between comorbidities with self-management intensive needs and depressive symptoms.

In a diverse sample of older adults with asthma, we found that depressive symptoms increased with each additional comorbidity but did not find that comorbidities with self-management intensive needs were significantly associated with depressive symptoms in adjusted models. The present findings emphasize the need for further study of the relationship between comorbidities and depressive symptoms among older adults with asthma. While the relationship between comorbidities and depressive symptoms have been found across chronic illnesses, it is especially important among older adults with asthma—as those experiencing depressive symptoms are more likely to have asthma-related emergency room and urgent care visits, worse quality of life, and higher frequency of asthma exacerbations than their non-depressed peers (1). Thus, further research in this area is of critical importance for older adults with complex care regimens. Finally, clinicians should consider and assess for the presence of depressive symptoms among older adults with asthma and comorbidities who are at greater risk for poor asthma outcomes, as well as provide appropriate referrals in the case of significant psychological symptoms.

Conflict of Interest

Dr. Wisnivesky received research grants from Sanofi, Banook and Quorum. All remaining authors declare that they do not have a conflict of interest.

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Table 1 *Summary of patient characteristics*

Variables	<i>n</i>	Mean (<i>SD</i>) or %
Age	389	67.6 (7.4)
Age group		
60-69	269	69%
70-79	83	21%
>80	37	10%
Gender		
Female	331	85%
Male	59	15%
Race ¹		
Black or African American	150	39%
Non-Hispanic White	74	19%
Asian/Pacific Islander	5	1%
Native American/Alaska Native	5	1%
Other	136	35%
Hispanic/Latino	219	56%
Puerto Rican	130	60%
Dominican	55	25%
Cuban/Cuban American	6	3%
Mexican/Mexican American	3	1%
Other Hispanic/Latino background	22	10%
Education		
Less than high school	163	42%
High school graduate	81	21%
Some college	84	21%
College graduate	62	16%
Income ²		
\$740 or less/month	90	26%
\$741 - \$1,350/month	140	41%
\$1,351 - \$3,000/month	75	22%
\$3,000 or more/month	38	11%
Marital Status		
Married or living with a partner	92	76%
Not married or living with a partner	298	24%
Interview completed in Spanish	154	39%
Asthma control (ACT score)	389	14.6 (3.9)
Comorbidities with self-management intensive needs		
Diabetes	152	39%
Hypertension	281	72%
Chronic heart failure	41	11%
Other comorbidities		
Allergies	243	62%
Anxiety	151	39%

Arthritis	294	75%
Coronary artery disease	52	13%
Eczema	49	13%
Gastro-esophageal reflux disease	208	53%
Hay Fever	105	27%
High cholesterol	209	54%
Liver disease	28	7%
Osteoporosis	103	26%
Sinusitis	129	33%
Stroke	38	10%

¹18 participants refused to provide information regarding their racial identity.

² 42 participants did not disclose their income category

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Table 2 *Unadjusted Associations of Patient Characteristics with Depressive Symptoms among Older Adults with Asthma*

Variables	Estimate (correlation or chi-square)	<i>p</i>
Age ¹	-.08	.12
Gender	1.13	.29
Race	8.97	.11
Ethnicity (Hispanic/Latino)	18.8	<.0001* *
Education	7.49	.06
Income	13.2	.004**
Marital Status	1.35	.24
Interview completed in Spanish	19.2	<.0001* *
Asthma control (ACT score) ¹	-0.22	<.0001* *

Note. * $p < .05$, ** $p < .01$. ¹ Spearman correlation. All other analyses used Kruskal Wallis/Wilcoxon rank sum test for non-normally distributed variables.

Table 3 Comorbidity burden and depressive symptoms (unadjusted and adjusted models)

Variables	Unadjusted	Adjusted				
	Estimate	Unstandardized coefficients b (SE)	Standardized coefficients β	p	95% CI	R^2
<i>Model 1</i>						
Step 1						.110
Race	.79 (.29)**	-.27 (.39)	-.05	.49	[-1.05, .50]	
Income	-1.99 (.60)**	-.44 (.25)	-.10	.08	[-.94, .06]	
Gender	-1.91 (1.54)	-1.03 (1.60)	-.03	.52	[-4.17, 2.11]	
Education	-1.16 (.48)*	.66 (.49)	.09	.18	[-.31, 1.63]	
Ethnicity	4.69 (1.08)**	2.27 (1.84)	.13	.14	[-.90, 6.35]	
Interview completed in Spanish	4.87 (1.10)**	2.73 (1.71)	.12	.11	[-.63, 6.10]	
Asthma control (ACT score)	-.63 (.14)**	-.63 (.15)	-.23	<.001*	[-.92, -.34]	
Step 2	-					.113
Race	-	-.25 (.39)	-.04	.52	[-1.03, .52]	
Income	-	-.45 (.25)	-.10	.08	[-.95, .05]	
Gender	-	-.88 (1.61)	-.03	.58	[-4.04, 2.28]	
Education	-	.72 (.49)	.09	.15	[-.25, 1.69]	
Ethnicity	-	2.79 (1.84)	.13	.13	[-.84, 6.42]	
Interview completed in Spanish	-	2.60 (1.71)	.12	.13	[-.77, 5.97]	
Asthma control (ACT score)	-	-.63 (.15)	-.23	<.001*	[-.92, -.34]	
Comorbidities with intensive self-management	1.34 (.65)*	.67 (.68)	.05	.32	[-.66, 2.01]	
<i>Model 2</i>						
Step 1						0.110
Race	-	-.27 (.39)	-.05	.49	[-1.02, .51]	

Income	-	-.44 (.25)	-.10	.08	[-.94, .06]	
Gender	-	-1.03 (1.60)	-.03	.52	[-4.17, 2.11]	
Education	-	.66 (.49)	0.09	.18	[-.31, 1.63]	
Ethnicity	-	2.27 (1.84)	.13	.14	[-.90, 6.35]	
Interview completed in Spanish	-	2.73 (1.71)	.12	.11	[-.63, 6.10]	
Asthma control (ACT score)	-	-.63 (.15)	-.23	<.001*	[-.92, -.34]	
Step 2						0.158
Race	-	-.17 (.38)	-.03	.66	[-.92, .59]	
Income	-	-.55 (.25)	-.12	.03*	[-1.04, -.06]	
Gender	-	.19 (1.58)	.01	.90	[-2.92, 3.31]	
Education	-	.61 (.48)	.08	.20	[-.33, 1.55]	
Ethnicity	-	2.9 (1.80)	.14	.10	[-.58, 6.49]	
Interview completed in Spanish	-	1.91 (1.67)	.09	.26	[-1.39, 5.20]	
Asthma control (ACT score)	-	-.55 (.14)	-.20	<.001*	[-.83, -.27]	
Comorbidity count	1.28 (.23)**	1.09 (.25)	.23	<.001*	[.60, 1.59]	

Note. * $p < .05$, ** $p < .01$.