

ASTHMA IN THE ELDERLY

Depressive Symptoms, Low Adherence, and Poor Asthma Outcomes in the Elderly

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Objective. To examine the impact of depressive symptoms on asthma outcomes and medication adherence in inner-city elderly patients with asthma. **Methods.** Cohort study of elderly asthmatics receiving primary care at three clinics in New York City and Chicago from 1 January 2010 to 1 January 2012. Depressive symptoms were ascertained with the Patient Health Questionnaire (PHQ-9). Outcomes included asthma control (Asthma Control Questionnaire, ACQ), asthma-related quality of life (Asthma Quality of Life Questionnaire, AQLQ), and acute resource utilization (inpatient and outpatient visits). Asthma medication adherence was evaluated using the Medication Adherence Reporting Scale (MARS). **Results.** Three hundred and seventeen participants ≥ 60 years were included in the study (83% women, 30% Hispanic, and 31% Black). In unadjusted analyses, participants with depressive symptoms were more likely to report poor asthma control ($p < .001$), worse AQLQ scores ($p < .001$), and higher rates of inpatient asthma-related visits (odds ratio [OR]: 2.03, 95% confidence interval [CI]: 1.04–3.99). Those with depressive symptoms also reported lower medication adherence (OR: 0.23, 95%CI: 0.10–0.54). Similar results were obtained in analyses adjusting for age, sex, race/ethnicity, income, asthma medication prescription, years with asthma, intubation history, comorbidities, and health literacy. **Conclusion.** In this cohort of elderly inner-city participants, depressive symptoms were associated with poorer asthma control and quality of life, as well as with lower rates of adherence to controller medications. Future work exploring possible mediators, including adherence, might elucidate the relationship between depression and poorer asthma outcomes in this population.

Keywords asthma, depression, elderly, outcomes, self-management

INTRODUCTION

Asthma prevalence in individuals aged ≥ 60 years is estimated to be 4–13%. The true prevalence of asthma in the elderly may be higher, as the disease is often underdiagnosed in elderly Americans (1–4). As the population in USA ages, the proportion of older patients with asthma is expected to grow. Unfortunately, asthma-related morbidity and mortality are increased in the elderly, and recent work underscores the need to better understand factors that contribute to the increased burden in this population (5–7). Furthermore, minority patients living in inner cities have higher asthma incidence, poorer disease control, and higher mortality (8,9). It is therefore imperative to target disease mechanisms in older urban adults with asthma to improve outcomes in this vulnerable population.

Depression is a highly prevalent comorbidity in adults with asthma, with several epidemiological studies showing an association between depression and asthma (10–14). Evidence also suggests that depression is associated with markers of asthma morbidity, including quality of life, asthma symptoms, health care utilization, and use of rescue medications (14,15). Depression and dysthymia are also prevalent among older adults in USA; however, there is little information about the potential impact of depression on outcomes of elderly asthmatics (16–19).

Regular use of asthma controller medications is associated with improved asthma outcomes and decreased asthma-related mortality (20–22). Despite this evidence, rates of adherence to controller medications are as low as 50%, even following hospitalization for asthma exacerbations (23). Several possible factors contribute to poor asthma medication adherence in the elderly, including cognitive impairment, diminished physical capacity to properly administer inhalers, and concern for medication-related side effects (24–26). Depression has been associated with medication and treatment nonadherence

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in a variety of medical conditions (27–30). Few studies, however, have examined the relationship between depression and adherence to treatment for asthma (31,32). Even more limited data are available assessing whether depression is associated with poorer asthma self-management in the elderly (33). Understanding the interrelationships of these factors may contribute to the development of effective interventions to improve clinical and quality of life outcomes for older adults.

The aims of this study were to assess associations between depressive symptoms and asthma outcomes in a cohort of inner-city older adults and to further examine the relationship between depressive symptoms and adherence to asthma controller medications in this vulnerable population.

PATIENTS AND METHODS

This cohort study included asthmatic patients ≥ 60 years of age recruited at three inner-city outpatient clinics in New York, NY, and Chicago, IL, beginning in December 2009. New York practices were based at the Mount Sinai Medical Center, a large academic medical center located in East Harlem. Chicago sites included the Northwestern University Hospital general internal medicine clinic and Mercy Health Clinic, a federally qualified health center. The study was approved by the Mount Sinai School of Medicine Program for the Protection of Human Subjects (HSM#11-00706) and the Northwestern University Institutional Review Board (STU00016454).

Potentially eligible asthmatic patients were identified at each site by review of electronic clinic encounter databases. We enrolled patients with a physician diagnosis of asthma who spoke English or Spanish and had uncontrolled disease (i.e., mild persistent disease or poorer control) (34). Individuals with a ≥ 10 pack-year smoking history or a diagnosis of chronic obstructive lung disease or other chronic respiratory illness were excluded. Individuals were also excluded if they had uncorrectable visual impairment, dementia, or were dependent on assistance for medication administration.

Trained, bilingual research assistants recruited patients by telephone; eligible patients were invited to provide in-person, written informed consent and subsequently underwent on-site study interviews using standardized English or Spanish questionnaires.

Assessment of Depressive Symptoms

Participants were assessed for symptoms of depression using the Patient Health Questionnaire [PHQ-9]), a tool based on DSM-IV criteria for identifying depressive symptoms that has been validated and widely used in a number of patient populations, including older adults and patients with asthma. A PHQ-9 score of ≥ 10 has an 88% sensitivity and 88% specificity for symptoms of major depression (35). Asthmatics with a PHQ-9 score ≥ 10 were classified as having symptoms suggestive of moderate or more severe depression (35–41).

Asthma Morbidity

Asthma control was evaluated using the Asthma Control Questionnaire (ACQ), an instrument validated in English and Spanish that includes items about asthma symptoms, activity limitation, and bronchodilator use (42). All questions were scored on a 7-point Likert scale, with higher scores indicating poorer asthma control; a difference ≥ 0.5 units has been associated with clinically important asthma control variability (43).

Asthma-related quality of life was assessed with the Mini-Asthma Quality of Life Questionnaire (AQLQ). The AQLQ is validated in English and Spanish and includes 15 items representing four overall domains: activity limitations, symptoms, emotional function, and environmental stimuli. Higher AQLQ scores correlate to better quality of life. A 0.5 point difference in scores indicates a clinically significant change in quality of life (44).

We collected self-reported information about acute asthma-related resource utilization in the 12 months prior to study interview, including the number of exacerbations requiring outpatient care (course of oral steroids or unscheduled physician visits) or inpatient care (emergency department [ED] or hospitalizations).

Asthma Controller Medication Adherence

Adherence to asthma controller medications (inhaled corticosteroids [ICS] and leukotriene receptor modifiers) was assessed using the Medication Adherence Reporting Scale (MARS). MARS is a validated, 10-item measure designed to minimize social desirability bias, and has been adapted to assess adherence to asthma medications (45). Each item is rated on a 5-point Likert scale, with higher scores indicating greater adherence; as in prior studies, participants with a MARS score of ≥ 4.5 were classified as having good adherence to controller medications (46,47).

Sociodemographic Characteristics and Other Covariates

Sociodemographic characteristics (age, sex, race/ethnicity, income), asthma history (number of years since diagnosis, history of intubation, and asthma medication prescription), and comorbid conditions were obtained using validated items (48,49). Health literacy was assessed using the Short Test of Functional Health Literacy in Adults (S-TOFHLA), a validated tool available in English and Spanish. Health literacy was classified as adequate (score ≥ 23) or low (score < 23) (50,51).

Statistical Analysis

Differences in baseline characteristics of asthmatics with and without depressive symptoms were evaluated using the chi-square or Wilcoxon test, as appropriate. Unadjusted associations between depressive symptoms and ACQ and AQLQ scores were assessed using a *t*-test. Rates of acute resource utilization and adherence among patients with and without depressive symptoms were compared using a chi-square test. The adjusted associations between depressive symptoms and asthma morbidity, as well as between depressive symptoms and adherence, were

assessed using multiple regression analyses (linear or logistic models, as appropriate), including the aforementioned covariates. All models were manually built using two-sided *p*-values with SAS statistical software (SAS Institute, Cary, NC, USA).

RESULTS

Between 1 January 2010 and 1 January 2012, 1189 potentially eligible participants were identified from the electronic clinic databases at study sites. Of these, five were deceased (<1%), we were unable to reach 162 (14%), 258 refused participation (22%), and 426 were excluded due to no history of asthma (16 %), COPD and other chronic lung diseases (4%), smoking history ≥ 10 pack-years (5%), cognitive impairment (<1%), and other reasons (9%). Eleven subjects dropped out of the study after enrollment and three patients died after consenting to participate but before completing study interviews. The final cohort included 317 participants, after an additional seven were excluded due to missing PHQ-9 scores.

Overall, 55 (17%) elderly patients with asthma reported clinically significant symptoms of depression. Compared to subjects without symptoms of depression, participants with significant depressive symptoms were younger ($p = .003$) and more likely to be female ($p = .04$), Hispanic ($p = .003$), born in Puerto Rico ($p < .001$), report an income below the federal poverty line ($p = .002$), and have fewer years of education ($p = .001$; Table 1). There were no significant differences across groups in the duration of asthma diagnosis ($p = .24$) or intubation rates ($p = .42$). Asthma management was also similar across study groups, with similar prescription rates of peak flow meters ($p = .89$), asthma action plans ($p = .12$), inhaled corticosteroids ($p = .32$), and leukotriene modifiers ($p = .41$). Diabetes was more prevalent among depressed subjects ($p = .01$); however, rates of other comorbidities, including congestive heart failure, hypertension, and atopic conditions, were similar ($p > .05$ for all comparisons).

Association of Depression Symptoms and Asthma Outcomes

In unadjusted analyses, participants with clinically significant depressive symptoms had significantly higher ACQ scores, indicating poorer asthma control (mean score difference: 1.01, $p < .001$; Table 2). AQLQ scores were lower in patients with depressive symptoms (mean score difference: -1.4 , $p < .001$), showing poorer quality of life. Older asthmatics with clinically significant symptoms of depression had similar odds of outpatient exacerbations (OR: 1.50, 95% confidence interval [CI]: 0.82–2.76) but reported increased odds for inpatient asthma-related visits (OR: 2.03, 95% CI: 1.04–3.99.). In adjusted analysis controlling for age, sex, race/ethnicity, income, asthma medication prescription, years with asthma, intubation history, comorbidities, and health literacy, most of these

TABLE 1.—Baseline characteristics of asthma patients with and without depressive symptoms.

	Moderate—severe depressive symptoms			<i>p</i> -Value
	Total (<i>n</i> = 317)	Absent (<i>n</i> = 262)	Present (<i>n</i> = 55)	
Age, years, No. (%)				
60–69	208 (69)	164 (65)	44 (86)	.003
70+	94 (31)	87 (35)	7 (14)	
Sex (%)				
Male	53 (17)	49 (19)	4 (7)	.04
Race/ethnicity, No. (%)				
White	87 (27)	78 (30)	9 (16)	.003
Black	104 (31)	90 (34)	14 (25)	
Hispanic	96 (30)	68 (26)	28 (51)	
Other	30 (12)	26 (10)	4 (8)	
Country of origin, No. (%)				
United States	214 (68)	187 (71)	27 (49)	<.001
Puerto Rico	64 (20)	41 (16)	23 (42)	
Other	39 (12)	34 (13)	5 (9)	
Yearly income, No. (%)				
$\leq 16,200/\text{yr}$	157 (50)	119 (46)	38 (69)	.002
Education, No. (%)				
<12 years	87 (27)	62 (24)	25 (46)	.001
Asthma history				
Yrs with asthma, median (IQR)	29 (35)	28 (35)	36.5 (32)	.24
Ever intubated, No. (%)	27 (9)	21 (8.4)	6 (12)	.42
Asthma management, No. (%)				
Has peak flow meter	141 (45)	117 (45)	24 (44)	.89
Has asthma action plan	72 (23)	64 (25)	8 (15)	.12
Prescribed inhaled corticosteroid	236 (75)	198 (76)	38 (69)	.32
Prescribed leukotriene modifier	77 (24)	66 (25)	11 (20)	.41
Comorbidity, No. (%)				
Allergy	212 (67)	175 (67)	37 (67)	.97
Eczema	48 (15)	42 (16)	6 (11)	.33
Sinusitis	114 (36)	90 (35)	24 (44)	.20
GERD	172 (54)	138 (53)	34 (62)	.23
Diabetes	84 (27)	62 (24)	22 (40)	.01
HTN	220 (70)	177 (68)	43 (78)	.13
CHF	31 (10)	28 (11)	3 (6)	.23
Low health literacy, No. (%)	92 (29)	74 (29)	18 (33)	.53

Notes: Yrs, years; GERD, gastroesophageal reflux disease; HTN, hypertension; CHF, congestive heart failure.

findings remained unchanged, with the exception of the association between depressive symptoms and inpatient resource utilization, which became insignificant (Table 3).

Association of Depression and Asthma Controller Medication Adherence

Participants with clinically significant depressive symptoms had considerably lower odds of adherence to controller medications for asthma (OR: 0.23, 95% CI: 0.10–0.54, Table 2) in unadjusted analyses. Similarly, the odds of adherence in adjusted analysis remained significantly lower (OR: 0.17, 95% CI: 0.06–0.49, Table 3) for participants with clinically significant symptoms of depression compared to those without after controlling for potential confounders.

TABLE 2.—Unadjusted associations between depressive symptoms and asthma outcomes.

Outcome	Moderate—severe depressive symptoms Present vs. absent	<i>p</i> -Value
	Mean score difference (SE)	
Asthma control ^a	1.0 (0.16)	<.001
Asthma quality of life ^b	−1.4 (0.18)	<.001
Outcome	Moderate—severe depressive symptoms Present vs. absent	<i>p</i> -Value
	Odds ratio (95% CI)	
Inpatient resource utilization ^c	2.03 (1.04–3.99)	.04
Outpatient resource utilization ^d	1.50 (0.82–2.76)	.2
Medication adherence	0.23 (0.10–0.54)	<.001

Notes: ^aHigher Asthma Control Questionnaire Scores indicate poorer asthma control. ^bLower Asthma Quality of Life Questionnaire Scores indicate poorer asthma quality of life. ^cInpatient resource utilization indicates any emergency department visits or hospitalizations for asthma flares in the prior 12 months. ^dOutpatient resource utilization indicates any unscheduled outpatient visit for asthma care and any visit at which oral steroids were prescribed for an asthma exacerbation.

TABLE 3.—Adjusted associations between depressive symptoms and asthma outcomes^a.

Outcome	Moderate—severe depressive symptoms Present vs. absent	<i>p</i> -Value
	Mean score difference (SE)	
Asthma control ^b	0.88 (0.17)	<.001
Asthma quality of life ^c	−1.15 (0.18)	<.001
Outcome	Moderate—severe depressive symptoms Present vs. absent	<i>p</i> -Value
	Odds ratio (95% CI)	
Inpatient resource utilization ^d	1.54 (0.86–3.48)	.30
Outpatient resource utilization ^e	1.64 (0.80–3.35)	.18
Medication adherence	0.17 (0.06–0.49)	.001

Notes: ^aAdjusted for age, sex, race/ethnicity, income, asthma medication prescription, years with asthma, intubation history, comorbidities, and health literacy. ^bHigher Asthma Control Questionnaire Scores indicate poorer asthma control. ^cLower Asthma Quality of Life Questionnaire Scores indicate poorer asthma quality of life. ^dInpatient resource utilization indicates any emergency department visits or hospitalizations for asthma flares in the prior 12 months. ^eOutpatient resource utilization indicates any unscheduled outpatient visit for asthma care and any visit at which oral steroids were prescribed for an asthma exacerbation.

DISCUSSION

Elderly inner-city patients with asthma have increased rates of poorly controlled asthma (8,9). Understanding the factors that contribute to increased morbidity in these patients is an important priority given the aging of the US population. Depression has been associated with poorer asthma outcomes in younger patients; depression is also a risk factor for low medication adherence in patients with other chronic diseases. In this cohort of elderly inner-city subjects, we found that clinically significant depressive symptoms were associated with poorer asthma control and quality of life, as well as lower rates of adherence to

controller medications. These findings suggest that low adherence may play a role in the relationship between depression and poorer asthma outcomes, and future work exploring mediators, including adherence, might elucidate this association and identify targets for interventions.

Prior studies have shown an association between increased morbidity and depression among younger asthmatics (13). A study of primarily young adults attending an inner-city asthma clinic showed that nearly half of participants met the criteria for depression based on psychiatric interviews. Participants with mood disorders were significantly more likely to use rescue inhalers and to present to the ED for asthma management (14). In a prospective analysis of 297 patients with asthma aged 16–60 years in West China, individuals with a combination of asthma and depression had an increased risk for asthma-related acute resource utilization (52). Mancuso et al. examined the association between patient-reported depressive symptoms and physician-reported depressive disorders with asthma outcomes in 257 patients with a mean age of 42 years. In adjusted analyses, depressive symptoms were significantly associated with worse asthma severity and poorer asthma control (53). While a few of these studies included some older adults, none compared the impact of depression in younger versus older asthmatics. Results from these studies highlight the need to evaluate the impact of depression on asthma self-management behaviors and outcomes, in particular in older adults, an under-studied population. Findings from our study of adults ≥60 years support an association between depressive symptoms and asthma outcomes, lending new evidence to these findings in the older adult population.

Our adjusted analysis showed that depressive symptoms were independently associated with poorer asthma outcomes, after adjusting for other, well-established risk factors. Moreover, the association between depressive symptoms with AQLQ and ACQ scores was the strongest among these factors, further underscoring the role that depression may play as a key determinant of asthma morbidity on older patients.

Limited work suggests an association between depression and asthma medication adherence among younger adults. In a small study of predominantly African-American women hospitalized for asthma exacerbations, self-reported depressive symptoms were common and associated with poorer post-discharge adherence to inhaled and oral steroids (31). Kaya et al. evaluated predictors of adherence to asthma action plans, and showed an association between depression and lower adherence to self-management plans among 63 participants (mean age of 43 years) followed for 12 months (32). While there may be distinct barriers to asthma medication adherence in the elderly, such as comorbid disease burden, cognitive and physical decline, and diminishing economic resources and social support, our results extend the findings of studies in younger asthmatics by showing that depressive symptoms may also negatively impact adherence to asthma controller medications in older adults, proper use of which is a cornerstone in achieving good asthma control.

There are several possible mechanisms underlying the relationship between depressive symptoms and low adherence to asthma medications. In studies by Bartlett et al. of children with asthma, maternal depressive symptoms was associated with lower asthma medication adherence, lower maternal self-efficacy to handle a child's attacks, and maternal reports of poorer understanding of their children's inhalers (54,55). In a small study of younger asthmatics, depression symptoms correlated with poorer acceptance of illness limitations, less illness-specific knowledge, and a decreased ability to identify worsening asthma symptoms (56). Mancuso et al. evaluated a self-management education intervention, addressing asthma knowledge and self-efficacy in patients with asthma as part of a randomized controlled trial. Results suggested improved quality of life scores in subjects with baseline depression symptoms following the intervention, suggesting that these factors may mediate the relationship between depression, low adherence, and poorer asthma outcomes (57). As these studies focused on younger populations, it remains important to evaluate whether these, as well as other mechanisms, underlie the relationship between depression and suboptimal self-management behaviors in older asthmatics.

Several limitations of this study merit comment. We relied on self-report to assess symptoms of depression, adherence, and asthma outcomes; thus, our measures may be subject to reporting bias. In particular, it has been suggested that adults with psychiatric conditions may over-perceive asthma symptoms, which, in turn, may not necessarily correlate with objective markers of disease severity (14). In terms of self-reported medication adherence, we chose to use the MARS questionnaire as it has been specifically designed to minimize social desirability bias and has been validated against objective measures of adherence.

This was a cross-sectional analysis; therefore, we cannot determine a casual relationship between depressive symptoms and asthma outcomes or medication adherence. Furthermore, we did not perform a formal mediation analysis or collect data on the potential pathways linking depression to low adherence or self-management behaviors. Future studies are necessary to identify modifiable factors that can be targeted with interventions to improve the outcomes of older asthmatics.

Our study was performed at two urban sites and our results may not generalize to other settings, especially as our sample was racially diverse. However, inner-city minority populations are a group at higher risk for poor asthma outcomes. Furthermore, this is one of the largest multi-center studies of asthma in the elderly to-date, and the sociodemographics of our patient population mirror those of other most US urban settings.

CONCLUSION

This study demonstrates an association between clinically significant symptoms of depression, increased asthma morbidity, and lower adherence to controller medications

among elderly inner-city asthmatics. These findings lend new data showing that depression is an important risk factor for poorer asthma outcomes and that medication adherence is a possible target for interventions focused on improving self-management in the elderly. Further research should determine which domains of self-management are most affected by depression symptoms, and whether treating depression improves adherence and asthma outcomes in this population. Targeting pathways linking depression with low medication adherence may be an effective way to improve outcomes in older adults with asthma.

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