



Assessing the association of obesity and asthma morbidity in older adults

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ABSTRACT

Background: Obesity is a robust predictor of poor asthma control in younger adults. Given the high prevalence of asthma and obesity in older Americans, weight reduction could benefit asthma management in this population.

Objective: To assess the association between obesity and asthma outcomes among older adults.

Methods: We recruited from urban primary care clinics a prospective cohort of nonsmoking individuals with asthma who were 60 years or older without a history of other respiratory diseases. At baseline, body mass index (BMI) measurements were classified as normal (BMI, 18–25), overweight (BMI, 25–30), or obese (BMI, >30). Measures of asthma morbidity (Asthma Control Questionnaire [ACQ], and Mini Asthma Quality of Life Questionnaire [Mini-AQLQ]) and asthma-related resource utilization (inpatient or outpatient) were taken at baseline and at 3- and 12-month interviews. We used generalized estimating equation models to assess associations between obesity and asthma outcomes after controlling for potential confounders.

Results: Of the 437 older adults with asthma in the study, 17% had a normal BMI, 32% were overweight, and 51% were obese. Unadjusted analyses revealed that obesity was associated with lower ACQ scores (odds ratio [OR], 1.19; 95% confidence interval [CI], 1.09–1.31) and poorer Mini-AQLQ scores (OR, 1.21; 95% CI, 1.11–1.33). Adjusted analyses revealed no significant association between obesity and ACQ (OR, 1.05; 95% CI, 0.96–1.15) and Mini-AQLQ (OR, 1.08; 95% CI, 0.99–1.19).

Conclusion: Our study suggests that obesity is not independently associated with worse asthma outcomes in older adults, reflecting potential differences in the mechanisms that link obesity with asthma control in older vs younger populations.

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Introduction

Asthma affects approximately 7% of adults older than 65 years in the United States^{1–3} and is frequently undiagnosed in elderly people.^{4–6} Compared with younger adults, older adults with

asthma experience a 4-fold greater rate of mortality,⁷ twice the rate of hospital admissions,⁸ and a significantly longer length of hospital stay.^{1,9,10}

Among children and younger individuals with asthma, a significant association has been found between obesity and asthma. Younger, obese individuals with asthma, many of whom first developed asthma during childhood,¹¹ have worse pulmonary function, higher asthma-related resource utilization, and greater asthma-related health care expenditures.^{12–14} Amid the rapidly increasing elderly demographic in the United States, obesity has been posited to play an important role as a cause of worsened asthma morbidity. However, there are still relatively few studies examining factors underlying asthma control in older patients,

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especially because observational studies of asthma have tended to include low numbers of elderly participants.¹⁵ The potential role of obesity as a cause of asthma morbidity in older adults thus remains unclear.

There are a number of notable differences in the pathophysiology of asthma and obesity as patients grow older, and consequently there is reason to believe that the obesity-asthma association in elderly individuals may be different from that of younger patients with asthma. First, the literature suggests that the pathophysiology of asthma in the elderly is less likely have an “atopic” component and more likely to have airway neutrophilia, both of which are not typically observed in younger asthmatic populations.¹⁶ Second, research in general patient populations has found that, opposite to observations among younger patients, the relative risk of all-cause mortality associated with increased body mass index (BMI) decreases with increased age.^{17,18} Although no studies have examined the association between asthma and obesity among elderly populations, research has found that a stronger association exists between obesity and obesity-related comorbidities, such as cardiovascular disease, dyslipidemia, hypertension, and type 2 diabetes in young and middle-aged populations than in elderly populations.¹⁹ These potential differences are further compounded by psychosocial problems, such as low health literacy, declining cognition, and depressive symptoms, that pose serious problems for asthma management in elderly individuals.^{20–22}

The number of obese elderly persons has been increasing in recent years and is expected to continue to increase.²³ Many studies in adults younger than 65 years report a positive association between obesity and asthma morbidity.^{12,14,24} Given the increasing number of aging patients with asthma and increasing obesity with aging, it is important to understand the potential role of obesity in the asthma outcomes in this at-risk population. We used data from a large longitudinal cohort study of older adults with asthma to evaluate the association between obesity and asthma control and asthma-related resource utilization.

Methods

Participants and Recruitment

The study used baseline, 3-month, and 12-month follow-up data from the Asthma Beliefs and Literacy in the Elderly study, a longitudinal cohort study of patients with asthma 60 years and older based in New York, New York, and Chicago, Illinois.

From December 2009 through May 2012, we recruited participants from 8 inner-city outpatient primary care, geriatrics, and pulmonary practices.^{21,25} Patients older than 60 years were eligible if they had moderate to severe persistent asthma as defined by the National Heart, Lung, and Blood Institute criteria.²⁶ Patients with a history of chronic respiratory illness, such as chronic obstructive pulmonary disease, were excluded from the study, as were patients with cognitive impairment or self-reported history of smoking for 10 or more pack-years.

Eligible participants underwent standardized in-person interviews conducted in English or Spanish. The study was approved by the institutional review boards of the Mount Sinai School of Medicine, Northwestern University Feinberg School of Medicine, and Lutheran Medical Center—Brooklyn.

Outcome Variables

The primary outcome variables were asthma control, asthma quality of life, and asthma-related resource utilization. Asthma control was assessed using of the Asthma Control Questionnaire (ACQ),²⁷ a validated tool that measures the extent to which participants have experienced asthma symptoms, such as sleep

disturbances, exercise limitation, shortness of breath, and disruption of daily activities. Higher scores indicate worse control; poor asthma control was defined as a score of 1.5 or higher.²¹

We assessed asthma quality of life with the Mini Asthma Quality of Life Questionnaire (Mini-AQLQ), which is composed of 15 questions on symptoms, activity limitations, emotional function, and environmental stimuli; higher scores indicate better quality of life.²⁸ With the use of established cutoffs, poor quality of life was defined as a score less than 4.7.²¹ For asthma-related acute care, we documented self-reported inpatient resource utilization (hospitalizations in the last 12 months for asthma) and outpatient resource utilization (unplanned visits to a physician for worsening asthma or attack in the last 6 months).²⁹

Independent Variables and Covariates

Obesity was determined by BMI, calculated as weight in kilograms divided by the square of height in meters from height and weight measures obtained during the in-person baseline interview. According to established criteria, patients with BMIs greater than 30, 25 to 30, and 18 to 25 were classified as obese, overweight, and normal weight, respectively.³⁰

Covariates included sociodemographic characteristics, asthma history, comorbidities, and measures of depression and anxiety. Sociodemographic data (age, sex, race, ethnicity, income, and educational level) were collected using validated measures. Asthma history included age of onset, history of intubation, and history of long-term use of oral steroids; onset of asthma before the age of 12 years was used as a cutoff for identifying childhood asthma.³¹ We obtained self-report information about physician diagnosis of comorbid conditions known to worsen asthma control, including eczema, hay fever, chronic sinusitis, and gastroesophageal reflux disease, as well as other chronic conditions common among older adults and/or potentially associated with obesity, such as hypertension, diabetes, congestive heart failure, osteoarthritis, and osteoporosis.

Depression symptoms were assessed using the Patient Health Questionnaire. A score of 10 or greater suggests moderate or more severe depression. Anxiety was assessed using the Generalized Anxiety Disorder 7 questionnaire. Scores of 10 or higher suggest moderate or more severe anxiety.³²

Statistical Analysis

We used the Kruskal-Wallis, analysis of variance, or χ^2 test to compare the baseline characteristics of patients in the obese, overweight, and normal BMI groups, as appropriate. The unadjusted association of obesity with ACQ scores, Mini-AQLQ scores, and asthma-related resource utilization were assessed using the analysis of variance or χ^2 test for continuous or dichotomous variables, respectively. Generalized estimating equation models with identity or logit links and robust SEs were used to examine the adjusted association between obesity and ACQ scores, Mini-AQLQ scores, and asthma-related resource utilization. Generalized estimating equation models allow using multiple observations from each participant (baseline, 3-month, and 12-month for ACQ and Mini-AQLQ scores; baseline and 3-month data for resource utilization data) while incorporating the correlated structure of the data. All models were adjusted for age, sex, income, childhood-onset asthma, comorbidities (allergies, sinusitis, gastroesophageal reflux disease, diabetes, hypertension, and congestive heart failure), anxiety, and depression. Analyses were conducted with SAS statistical software (SAS Institute Inc, Cary, North Carolina) using 2-sided *P* values.

Results

Baseline Characteristics of the Study Participants

Of 1,972 patients who were identified as eligible via electronic medical records, 466 were unable to be contacted, 481 refused participation, and 1,025 were screened for eligibility. A total of 502 participants were eligible after screening, with 452 successfully scheduling and completing baseline interviews.

Of 437 study participants (with data on BMI) who completed asthma outcomes assessments, 76 (17%) had a BMI within the normal range, 140 (32%) were overweight, and 221 (51%) were obese. Table 1 reveals that obese patients were more likely to be female ($P < .001$), to have not graduated high school ($P < .001$), to have a history of intubation for asthma ($P = .002$), and to have had unplanned physician visits in the last 6 months for worsening asthma or attack ($P = .01$). Obese patients were less likely to have monthly incomes above \$3,000 ($P < .001$). No significant differences were found in the distribution of age, race/ethnicity, health literacy, and asthma-related resource utilization ($P > .05$ for all comparisons) by obesity status.

There was variability in the distribution of comorbidities across the 3 levels of BMI (Table 1). Obese and overweight patients were more likely to report sinusitis ($P = .02$), congestive heart failure ($P = .04$), hypertension ($P < .001$), diabetes mellitus ($P < .001$), arthritis ($P < .001$), and depression ($P = .02$). Patients who were obese were marginally less likely to have allergies ($P = .05$). No statistically significant associations were found between obesity

and childhood-onset asthma, hay fever, gastroesophageal reflux disease, eczema, osteoporosis, and anxiety ($P > .05$ for all comparisons).

Unadjusted Association Between Obesity and Asthma Outcomes

In univariate analysis, obese patients, compared with patients of normal weight, had greater odds of poor ACQ scores (odds ratio [OR], 1.21; 95% confidence interval [CI], 1.09–1.31), poor Mini-AQLQ scores (OR, 1.21; 95% CI, 1.11–1.33) (Table 2), and outpatient resource utilization (OR, 1.17; 95% CI, 1.07–1.28). Overweight patients also had higher odds of poor ACQ scores (OR, 1.13; 95% CI, 1.02–1.24), poor Mini-AQLQ scores (OR, 1.14; 95% CI, 1.03–1.26), and outpatient resource utilization (OR, 1.13; 95% CI, 1.03–1.24) compared with those with normal weight. No significant associations were found between obesity or overweight with inpatient resource utilization ($P > .05$).

Adjusted Asthma Outcomes by Obesity Level

After adjustment for sociodemographic and health status variables, obesity was no longer significantly associated with poor ACQ scores (OR, 1.05; 95% CI, 0.96–1.15) (Table 3) or diminished Mini-AQLQ scores (OR, 1.08; 95% CI, 0.99–1.19). In adjusted analysis, obesity was not associated with inpatient and outpatient resource utilization ($P > .05$ for both comparisons). In addition, no association was found between the overweight status and poor ACQ

Table 1
Baseline Characteristics of Study Participants^a

Characteristic	All	Normal weight (n = 76)	Overweight (n = 140)	Obese (n = 221)	P value
Age, mean (SD), y	67.5 (6.8)	69.2 (8.4)	67.1 (5.8)	67.3 (6.7)	.28
Female	369 (84)	58 (76)	110 (79)	201 (91)	<.001
Monthly income, \$					<.001
\$750	102 (24)	19 (26)	24 (17)	59 (27)	
\$751–\$1,350	134 (31)	12 (16)	41 (30)	81 (38)	
\$1,351–\$3,000	102 (24)	22 (30)	34 (25)	46 (21)	
≥\$3,001	89 (21)	21 (28)	39 (28)	29 (13)	
Race/ethnicity					.14
White	94 (22)	31 (41)	38 (27)	25 (11)	
Black	134 (31)	16 (21)	40 (29)	78 (35)	
Hispanic	173 (40)	22 (29)	50 (36)	101 (46)	
Other	36 (8)	7 (9)	12 (9)	17 (8)	
Educational level					<.001
Some high school	150 (34)	16 (21)	42 (30)	92 (42)	
High school graduate	73 (17)	6 (8)	24 (17)	43 (20)	
Some college	88 (20)	18 (24)	24 (17)	46 (21)	
Four-year college graduate	125 (29)	36 (47)	50 (36)	39 (18)	
Adequate health literacy	271 (64)	53 (71)	91 (67)	127 (60)	.14
Resource utilization					
Ever intubated	40 (9)	6 (8)	7 (5)	27 (12)	.002
Inpatient in last 12 months ^b	105 (24)	5 (7)	10 (7)	27 (12)	.12
Outpatient in last 6 months ^c	198 (46)	17 (23)	47 (34)	77 (35)	.01
Childhood asthma ^d	88 (20)	56 (76)	109 (78)	178 (82)	.42
Comorbidities					
Allergies	285 (65)	58 (76)	93 (66)	134 (61)	.05
Hay fever	130 (30)	25 (33)	41 (29)	64 (29)	.81
Sinusitis	142 (33)	18 (24)	57 (41)	67 (30)	.02
Gastroesophageal reflux disease	246 (56)	38 (50)	76 (54)	132 (60)	.26
Diabetes mellitus	146 (33)	10 (13)	30 (21)	106 (48)	<.001
Hypertension	322 (74)	40 (53)	97 (69)	185 (84)	<.001
Congestive heart failure	58 (13)	8 (10)	12 (9)	38 (17)	.04
Eczema	63 (16)	13 (17)	23 (16)	33 (15)	.89
Osteoporosis	123 (28)	27 (36)	39 (28)	57 (26)	.27
Arthritis	301 (69)	44 (58)	86 (62)	171 (78)	<.001
Depression	91 (21)	8 (11)	28 (20)	55 (26)	.02
Anxiety	92 (21)	16 (22)	25 (18)	51 (23)	.48

^aData are presented as number (percentage) of study participants unless otherwise indicated.

^bHospital admissions in last 12 months for asthma.

^cUnplanned physician visit in last 6 months for worsening asthma or attack.

^dAsthma onset before 12 years of age.

Table 2

Unadjusted Analysis of Obesity and Asthma Control, Quality of Life, and Asthma-Related Resource Utilization According to Weight

Weight category	OR (95% CI)			
	Poor asthma control	Poor Mini-AQLQ	Inpatient resource ^a	Outpatient resource ^b
Normal	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Overweight	1.13 (1.02–1.24)	1.14 (1.03–1.26)	0.99 (0.94–1.04)	1.13 (1.03–1.24)
Obese	1.19 (1.09–1.31)	1.21 (1.11–1.33)	1.02 (0.97–1.08)	1.17 (1.07–1.28)

Abbreviations: AQLQ, Asthma Quality of Life Questionnaire; CI, confidence interval; OR, odds ratio.

^aHospital admissions in last 12 months for asthma.^bUnplanned physician visit in last 6 months for worsening asthma or attack.

scores, poor Mini-AQLQ scores, and inpatient and outpatient resource utilization ($P > .05$ for all comparisons).

Discussion

We found that obesity is not independently associated with poor asthma control and quality of life in a large elderly cohort, injecting uncertainty into an obesity-asthma association posited to exist in the elderly population. Our findings thus differ from research of asthma and obesity in adults of younger ages, where obesity has a consistent association with poor asthma outcomes.^{12–14} Further understanding of the differences in the association between obesity and asthma control will require identification of the pathophysiologic differences between asthma in younger and older adults with asthma.

One reason for the lack of an asthma-obesity association observed in our elderly sample may be related to an altered perception of respiratory symptoms in the elderly population. Not only has research found that aging is accompanied by impaired perception of dyspnea,^{33–35} but also patients with impaired perception of respiratory morbidities have been found to have poor asthma control and worse symptom management overall.³⁶ It is unclear, however, whether obesity may further affect symptom perception in older people with asthma.

Our study also found younger age, lower income, and depression to be associated with worse asthma self-management, and we considered the possibility that these factors may confound the association between obesity and asthma control. We found that when depression, age, and income were together removed from the final model, the association between obesity and poor asthma control became significant, suggesting that a combination of socioeconomic factors and depression may confound the association between obesity and asthma control. Further studies are needed on the role that socioeconomic factors and depression may play in the association between obesity and asthma in the elderly population.

This study has some limitations worth noting. Our study relied on self-report data for resource utilization, raising the possibility of recall bias or incomplete reporting. However, we used validated items and specifically limited the recall period to 12 months and asked about any hospitalization or emergency department visit, rather than total number of visits, an approach that may mitigate the possibility of recall problems. The generalizability of our findings may also be limited by our recruitment from inner-city community and hospital-based primary care practices. However, these are the populations at higher risk of poor asthma outcomes. Finally, our study was limited by its reliance on self-reported history of allergies. Future studies examining the association

Table 3

Adjusted Analysis for Obesity and Asthma Control, Quality of Life, and Asthma-Related Resource Utilization According to Weight

	OR (95% CI)			
	Poor Asthma Control	Poor Mini-AQLQ	Inpatient resource ^a	Outpatient resource ^b
Weight category				
Normal	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Overweight	1.05 (0.96–1.15)	1.09 (0.99–1.20)	0.99 (0.94–1.04)	1.09 (0.99–1.21)
Obese	1.04 (0.95–1.14)	1.09 (0.99–1.20)	1.00 (0.94–1.05)	1.10 (0.99–1.22)
Age	0.99 (0.99–1.00)	0.99 (0.99–1.00)	1.00 (1.00–1.00)	0.99 (0.99–1.00)
Female sex	1.02 (0.98–1.07)	1.04 (0.99–1.08)	1.01 (0.99–1.03)	1.02 (0.98–1.07)
Income, \$				
≤750	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
751–1,350	0.80 (0.71–0.90)	0.78 (0.70–0.86)	0.96 (0.91–1.02)	1.01 (0.91–1.11)
1,351–3,000	0.96 (0.88–1.06)	0.93 (0.84–1.03)	1.00 (0.93–1.07)	1.06 (0.95–1.18)
≥3,001	0.94 (0.85–1.04)	0.90 (0.81–1.01)	0.97 (0.91–1.02)	1.00 (0.89–1.12)
Race				
White	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Black	1.10 (0.99–1.22)	1.00 (0.91–1.10)	1.00 (0.96–1.05)	1.07 (0.97–1.19)
Hispanic	1.10 (0.98–1.22)	1.13 (1.01–1.26)	1.04 (0.98–1.11)	1.06 (0.95–1.19)
Other	0.98 (0.87–1.11)	0.97 (0.85–1.10)	1.00 (0.95–1.06)	1.04 (0.90–1.20)
Childhood asthma	0.95 (0.87–1.03)	0.98 (0.90–1.07)	0.99 (0.94–1.03)	1.01 (0.92–1.10)
Comorbidities				
Allergies	1.01 (0.94–1.09)	1.07 (0.99–1.14)	1.03 (0.99–1.07)	1.03 (0.95–1.11)
Sinusitis	1.04 (0.96–1.12)	1.05 (0.97–1.13)	0.98 (0.95–1.02)	1.00 (0.92–1.08)
GERD	1.09 (1.02–1.17)	1.06 (0.99–1.13)	1.01 (0.98–1.05)	1.08 (1.00–1.16)
Diabetes	0.99 (0.91–1.08)	1.02 (0.93–1.10)	1.00 (0.95–1.05)	1.04 (0.96–1.13)
Hypertension	0.96 (0.88–1.04)	0.98 (0.91–1.06)	1.06 (1.02–1.10)	0.93 (0.85–1.02)
CHF	1.05 (0.94–1.17)	1.02 (0.91–1.14)	1.06 (0.99–1.14)	1.13 (1.02–1.26)
Depression	1.20 (1.08–1.34)	1.21 (1.09–1.34)	0.95 (0.89–1.02)	1.08 (0.97–1.21)
Anxiety	1.08 (0.97–1.20)	1.07 (0.97–1.17)	1.05 (0.98–1.12)	0.99 (0.89–1.11)

Abbreviations: AQLQ, Asthma Quality of Life Questionnaire; CHF, congestive heart failure; CI, confidence interval; GERD, gastroesophageal reflux disease; OR, odds ratio.

^aHospital admissions in last 12 months for asthma.^bUnplanned physician visit in last 6 months for worsening asthma or attack.

between asthma and obesity should involve collection of objective measures to establish allergy status.

To our knowledge, this study was the first to examine the association between obesity and asthma in a sample of older people with asthma without a history of smoking or chronic obstructive pulmonary disease. Although previous studies have suggested that weight reduction, including bariatric surgery, may benefit younger asthmatic populations,^{14,37} our study found that obesity is not independently associated with worse asthma outcomes in older adults. The lack of an association between the two raises the possibility that determinants of asthma control differ between younger and older adults with asthma, thus illustrating the need for asthma interventions to be specifically tailored for older adults. Additional research is needed to confirm our findings, and future studies should aim to compare asthma symptoms in the elderly population with symptoms in adults younger than 60 years to better understand the differences between obesity-asthma dynamics in the 2 age groups.

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