

Quality of Life, Health Care Utilization, and Control in Older Adults with Asthma

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What is already known about this topic? In the United States, patients older than 65 years have the highest asthma mortality rate of any age group, accounting for more than 50% of all asthma deaths. This population has been inadequately studied and historically undertreated, and predictors of poor asthma quality of life and control remain largely unknown.

What does this article add to our knowledge? Concurrent depression is strongly associated with poor asthma quality of life and control. In addition, poorer functional status, both physical and mental, is associated with diminished quality of life and living alone predicts greater health care utilization. Standard, objective measures of asthma control, including spirometric and exhaled nitric oxide results, were not found to be associated with asthma outcomes in older adults with asthma.

How does this study impact current management guidelines? This study suggests that a more integrative, non-traditional approach is needed in older adults with asthma, with treatment of not only the physical aspects of asthma but the psychological and social aspects as well.

BACKGROUND: Older adults with asthma have worse quality of life, asthma control and increased health care utilization than do healthy peers. Factors that contribute to this are currently unknown.

OBJECTIVE: To identify demographic, psychological or physiologic characteristics associated with asthma quality of life, control and health care utilization in older adults.

METHODS: By using a cross-sectional design, subjects older than 65 years with a history of physician-diagnosed asthma were enrolled. Demographic, psychological and physiological characteristics (including spirometry, atopy testing and exhaled nitric oxide) were collected. Correlations between these factors and the mini Asthma Quality of Life Questionnaire, Asthma Control Questionnaire and health care utilization were assessed.

RESULTS: Seventy subjects were enrolled in the study, with a mean age of 73.3 years and mean duration of asthma diagnosis of 28.5 years. Higher depression screening scores and self-reported depression were strongly correlated with poorer quality

of life and asthma control after controlling for confounding effects through a regression model. In addition, worse overall functional status was correlated with poorer asthma quality of life ($P < .01$), presence of atopy was associated with decreased health care utilization ($P < .01$) and subjects who lived alone were more likely to have unscheduled visits to a physician's office ($P = .06$). **CONCLUSIONS:** Comorbid depression is strongly associated with poorer asthma quality of life and control in older adults. In addition, worse functional status and living alone may be associated with poorer outcomes. Screening for these conditions is important in the care of the elderly asthmatic population. © 2013 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol: In Practice 2013;1:157-62)

Key words: Asthma; Older adults; Elderly; Quality of life; Asthma control; Health care utilization; Depression; Living situation

Approximately 34.1 million Americans and 300 million people worldwide have been diagnosed with asthma by a health professional during their lifetime,¹ with nearly 3500 annual deaths attributed to the disease in the United States.² Physicians and patients often erroneously believe that asthma is a disease that affects only children or begins only in childhood. In fact, studies show that up to 40% of adults with asthma have their first attack after the age of 40 years.^{3,4} Under-diagnosis and delayed initiation of care for asthma is common and can have dire consequences in the elderly.⁵ In the United States, patients older than 65 years have the highest asthma mortality rate of any age group, accounting for more than 50% of all asthma deaths.^{6,7}

Unfortunately, little research has focused on optimal treatment and diagnostic strategies in this population. In fact, many asthma trials have excluded potential subjects older than 65 years.⁸⁻¹⁰ A previous European study has shown that older adults with a diagnosis of asthma have poorer quality of life than do healthy controls.¹¹ A more recent study using a US geriatric asthmatic population has demonstrated similar results, documenting not only reduced quality of life but also increased health care

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Abbreviations used

ACQ6- Asthma Control Questionnaire
 CES-D8- 8-item version of the Center for Epidemiologic Studies
 Depression Scale
 ER- emergency room
 FENO- fraction of exhaled nitric oxide
 FEV₁- forced expiratory volume in 1 s
 mAQLQ- mini Asthma Quality of Life Questionnaire
 SF- short form

utilization when compared with healthy peers.¹² Recently, the National Institute on Aging sponsored a Workshop on Asthma in the Elderly, with aims to identify knowledge gaps and areas for future research. As a part of this meeting, 29 distinct areas of future research needs were recognized, including a current lack of information regarding factors that contribute to poorer asthma quality of life and control in the elderly population.¹³ The aim of our study was to identify demographic, psychological or physiologic characteristics that correlate with asthma quality of life, asthma control and health care utilization in older adults.

METHODS

By using a cross-sectional design, subjects were recruited from the University of Michigan asthma registry, which includes patients in both community and tertiary centre clinics. The registry identifies “persistent asthmatics” on the basis of a physician diagnosis of asthma and the need for daily asthma controller medication. Each subject’s eligibility was verified by a member of the research team before being enrolled in the study. Inclusion criteria included age more than 65 years, physician-diagnosed asthma based on the National Institutes of Health/National Asthma Education and Prevention Program guidelines,¹⁴ need for daily asthma control medications and access to a telephone. Exclusion criteria included smoking history of more than 20 pack-years, current smoking, chronic obstructive pulmonary disease and mental impairment that would limit ability to complete the required questionnaires. The protocol was approved through the University of Michigan Internal Review Board, and all questionnaires were used with the permission of the developers. This study was a part of a randomized controlled trial of asthma in older adults (clinicaltrials.gov- NCT00941694). The sample size was based on a power analysis for that study. After obtaining written informed consent, 70 subjects were enrolled in this study.

Predictors

Baseline demographic data were collected through a telephone-administered questionnaire, and self-reported responses were used for data analysis. The baseline data included current age, body mass index, gender, language most often spoken at home, highest education level, marital status, age of asthma onset, number of self-reported asthma attacks occurring in the previous 12 months, health care utilization within the previous 12 months (emergency room [ER] visits, hospitalizations and unscheduled visits to the primary/specialty care provider), number of oral steroid courses within the past 12 months, self-reported comorbidities, severity based on current medication regimen used for asthma control and medication adherence. Asthma severity was classified as “mild” for those using monotherapy (inhaled corticosteroid or other single agent), “moderate” if requiring an inhaled corticosteroid plus one additional

controller medication and “severe” if requiring an inhaled corticosteroid plus two or more additional asthma control medications, based on the National Institutes of Health guidelines.¹⁴

Additional measures included the 12-item Short-Form (SF) Health Survey¹⁵ and the 8-item version of the Center for Epidemiologic Studies Depression Scale (CES-D8).¹⁶⁻¹⁹ The 12-item Short-Form Health Survey is a survey designed to gather information about functional health and well-being from the patient’s point of view. The survey provides distinct physical and mental component summaries, calibrated so that a score of 50 ± 10 is considered average or the norm, based on a study of the US general population in 1998. Higher scores represent greater well-being. The CES-D8 is an abbreviated, validated tool based on the CES-D20, used for the screening of symptoms suggestive of depression.¹⁶ This 8-item questionnaire is designed to measure depressive symptomatology in the general population, and it has been used successfully in research protocols as a concise depression screening tool.¹⁷⁻¹⁹ Each item response is given a score of 0, 1, 2 or 3, and then totalled, with a resulting score ranging between 0 and 24. A higher score on the CES-D8 indicates increasing levels of psychological distress.

Objective measures of asthma control included fraction of exhaled nitric oxide (FENO) levels and spirometric data (forced expiratory volume in 1 s [FEV₁], forced vital capacity and FEV₁/forced vital capacity ratio), collected in accordance with the American Thoracic Society guidelines.²⁰ Spirometry was performed by using a portable device (Renaissance II; Puritan Bennett, Boulder, Colo). Exhaled nitric oxide measurements were performed taken by using a portable device (NIOX MINO; Aerocrine, Inc, New Providence, NJ). Allergy skin tests were carried out with the Duotip-test device (Lincoln Diagnostics, Inc, Decatur, Ill), using 10 tests including a variety of common aeroallergen mixes, and a histamine and saline control. Commercially available skin test materials were used (Greer; Lenoir, NC). Testing and interpretation was carried out according to Practice Parameter guidelines.²¹

Outcome measures

The primary outcome for our study was the mini Asthma Quality of Life Questionnaire (mAQLQ) score.²² The mAQLQ is a 15-item self- or interview-administered survey developed to measure functional impairments most problematic to adult patients with asthma. It is derived from the original 32-item AQLQ, and it been shown to effectively evaluate four domains, symptoms, activity limitation, emotional function and environmental stimuli, which can be scored independently. This survey was specifically designed to provide concise data and for ease of use during clinical trials.²³ Answers are given on a seven-point scale (0-6), and a final score is derived from the average for the 15 items. A lower score indicates greater functional impairment.

In addition, scores on the Asthma Control Questionnaire 6 (ACQ6)²⁴ were obtained. The ACQ6 is a validated survey with six questions, measuring the control of asthma based on goals of management, including nighttime symptoms, waking symptoms, limitation of daily activities, shortness of breath, wheezing and daily rescue bronchodilator use. Responses are measured on a seven-point scale (0-6). All responses are averaged, with lower scores representing better control.²⁵

To further assess asthma control, measures of health care utilization over the previous 12 months were collected. These included the number of asthma attacks, ER visits, unscheduled

TABLE I. Demographic distribution (n = 70)

Age (y), mean $\pm$ SD	73.3 $\pm$ 6.3
Duration of asthma diagnosis (y), mean $\pm$ SD	28.5 $\pm$ 22.2
Gender (female)	54 (77.1)
Living situation (n = 69)	
Alone	24 (34.3)
With 1+ person	45 (64.3)
Current marital status (n = 69)	
Married	37 (52.9)
Never married	3 (4.3)
Divorced	13 (18.6)
Widowed	16 (22.9)
Ethnicity (n = 69)	
Caucasian/White	56 (80)
African-American/Black	7 (10)
Other	7 (10)
Highest education completed	
High school or less	32 (45.8)
4-y college	7 (10.0)
Postgraduate	31 (44.3)
Self-reported comorbidities	
Hypertension	37 (52.9)
Heart disease/stroke	18 (25.7)
Depression	10 (14.2)
Cancer	15 (21.4)
Heartburn/gastroesophageal reflux disease	27 (38.6)
Arthritis	43 (61.4)
Glaucoma/cataracts	33 (47.1)
Memory problems/Alzheimer's disease	11 (15.7)
Allergic rhinitis/"hay fever"	49 (70.0)
Other	20 (28.6)
Atopy by skin testing	54 (77.1)
Use of alternative therapy	19 (27.1)

All data presented as n (%) unless otherwise noted.

visits to a primary or specialty care outpatient physician, hospitalizations and oral steroids courses.

Statistical analysis

Pearson's χ^2 test was used to conduct univariate analysis for mAQLQ and ACQ scores. To examine associations, mAQLQ (and its domains) and ACQ scores were regressed one at a time against each of the predictors (age, body mass index, gender, race, education [dichotomized into high school and below or above high school education], FENO levels, spirometric levels, SF health [mental and physical] scores, CES-D8, living situation [whether subject lives alone or not], depression, atopy, medical category and age of diagnosis). Number of asthma attacks, ER visits, unscheduled visits, hospitalizations and oral steroid courses were also dichotomized. In addition, ACQ6 scores were dichotomized into controlled (≤ 1.0) or uncontrolled (> 1.0) on the basis of developer's recommendations.^{24,25} Similarly, the dichotomized responses were then regressed against each predictor in a logistic regression model to assess for association.

Using results from univariate analysis, regression analysis for each response was conducted for predictors that were significant at the 0.20 level using linear (for continuous responses) and logistic (for dichotomous responses) regression. Backward elimination with a cutoff value of 0.05 was used to obtain the final model for each response.

TABLE II. Objective and questionnaire-obtained asthma data

FENO (ppb)	30.9 $\pm$ 30.0
FEV ₁ % predicted	82.5 $\pm$ 25.4
FVC% predicted	85.65 $\pm$ 23.2
Attacks in past 12 mo	4.64 $\pm$ 19.56
Hospitalizations in past 12 mo	0.13 $\pm$ 0.45
ER visits in past 12 mo	0.07 $\pm$ 0.354
Unscheduled visits in past 12 mo	0.47 $\pm$ 1.018
Oral steroid courses in past 12 mo	0.3 $\pm$ 0.713
Asthma severity, n (%)	
Mild	23 (31.9)
Moderate	35 (48.6)
Severe	11 (15.3)
Takes asthma medicines, n (%)	
Some of the time	3 (4.3)
Most of the time	14 (20)
All of the time	53 (75.7)

FVC, Forced vital capacity.

All data presented as mean $\pm$ SD unless otherwise noted.

RESULTS

Characteristics of our population

After recruitment, 70 subjects were included for analysis. Demographic characteristics are summarized in Table I. The mean age of those enrolled was 73.3 years (range, 66-92 years), with a 77.1% female and 80% Caucasian distribution. The mean duration of asthma diagnosis was 28.5 years. A wide range of self-reported comorbid conditions was described (mean 3.63), with 68 out of the 70 subjects (97.1%) noting at least one comorbid condition.

All subjects enrolled were able to appropriately complete both exhaled nitric oxide (FENO) and spirometric data collection, as shown in Table II. The mean FEV₁% predicted was 82.5%. Asthma severity, based on medication use, was well distributed amongst all categories, with approximately 80% of the patients in the mild to moderate range.

Mean scores for the CESD-8, SF mental, SF physical, mAQLQ and the ACQ6 are as follows: CESD-8 3.60 $\pm$ 3.75, SF mental 53.13 $\pm$ 7.67, SF physical 43.63 $\pm$ 9.3, mAQLQ 5.66 $\pm$ 0.93 and ACQ6 1.21 $\pm$ 0.82. CESD-8 scores in our population are elevated, indicating greater depression, when compared with results from a study of the general geriatric population,²⁶ but follow a similar trend seen in a study of adult patients with chronic obstructive pulmonary disease.²⁷ SF mental and physical scores were comparable to data collected from the National Survey of Functional Health Status and the Medical Outcomes Study.¹⁵ mAQLQ scores were similar to those in previous studies in adult asthmatic patients.²³

Factors correlated with mAQLQ or ACQ6

Univariate analysis between the collected predictors and mAQLQ or ACQ6 was determined through Person's χ^2 analysis. Increased CESD-8 scores (marker of greater depression), self-reported depression and higher body mass index were associated with poorer quality of life. Higher forced vital capacity, education and SF physical and SF mental scores were significantly correlated with better quality of life. When assessing asthma control with the ACQ6, increased CESD-8 scores, self-reported depression and African American race were associated with worse

TABLE III. AQLQ and AQLQ subtype regression analysis outcomes

Outcome	Predictors	β	95% CI	Partial R^2	P value
AQLQ	CES-D8	-0.13	-0.18, -0.08	0.27	<.01
	SF physical	0.03	0.01, 0.06	0.09	<.01
	SF mental	0.04	0.01, 0.06	0.10	<.01
	Living situation	-0.40	-0.84, 0.03	0.04	.07
AQLQ-symptoms	CES-D8	-0.09	-0.15, -0.03	0.12	<.01
	SF physical*	0.03	0.002, 0.05	0.07	.03
AQLQ-emotional	CES-D8	-0.09	-0.15, -0.03	0.13	<.01
	SF mental*	0.04	0.005, 0.07	0.07	.02
AQLQ-environmental	CES-D8	-0.13	-0.22, -0.04	0.09	<.01
	FVC actual	0.62	0.10, 1.13	0.07	.02
	FEV ₁ %	-0.02	-0.03, -0.001	0.05	.04
AQLQ-activity	CES-D8	-0.13	-0.20, -0.07	0.12	<.01
	SF physical	0.03	0.02, 0.05	0.04	.04
	Living situation	-0.51	-0.96, -0.06	0.04	.03
	Self-reported depression	-0.74	-1.41, -0.08	0.04	.03
	SF mental*	0.05	0.02, 0.08	0.09	<.01

CI, Confidence interval; FVC, forced vital capacity.

*Data after removal of CES-D8 because of collinearity.

asthma control. Higher education and SF physical score were significantly correlated with better asthma control.

Factors correlated with health care utilization

Univariate analysis of collected predictors and measures of health care utilization demonstrated a correlation between the presence of atopy and decreased number of hospitalizations, unscheduled visits to the primary care physician or asthma specialist and number of oral steroid courses in the previous 12 months. In addition, living alone correlated with increased number of unscheduled visits to the primary care physician or asthma specialist. No statistically significant associations were seen with the number of asthma attacks in the previous year.

Regression analysis

Quality-of-life data. After regression analysis, a greater severity of depression on the CES-D8 remained significantly associated with poorer quality of life. In addition, CES-D8 was associated with poorer quality of life within each of the four domains of the mAQLQ (symptoms, activity limitation, emotional function and environmental stimuli) upon sub-group analysis (Table III). The CES-D8 had the highest partial R^2 value for the overall mAQLQ and each domain and accounted for 27% of the variability of the overall mAQLQ.

During analysis, significant collinearity was observed between CES-D8 and self-reported depression; therefore, the data were analysed by using only self-reported depression rather than CES-D8. After removal of CES-D8 scores from analysis, lower SF physical and lower SF mental scores remained significantly associated with poorer quality of life.

Asthma control data. Higher scores on the ACQ6 (worse control) were associated with increasing depression severity on

the CES-D8 (Table IV). As with the mAQLQ analysis, the CES-D8 demonstrated the highest partial R^2 value of any variable entered into the regression analysis. After removal of CES-D8 from analysis secondary to collinearity, African American race compared with Caucasian counterparts and self-reported depression also remained significant. According to Juniper et al,²⁵ a score of 1.0 on the ACQ6 can be considered a crossover point between “well-controlled” and “not well-controlled”; therefore, logistic regression with ACQ6 dichotomized at 1.0 was performed and continued to demonstrate depression and African American race as predicting factors for poorer asthma control (Table IV). Poorer physical health status also approached significance, with higher scores for both continuous and dichotomized ACQ6. No correlation between spirometric data or FENO levels and quality of life or asthma control was noted.

Health care utilization. After logistic regression, atopy remained statistically significant as a predictor of fewer hospitalizations, unscheduled visits to the primary care physician or asthma specialist and number of oral steroid courses in the previous 12 months. In addition, living alone was associated with an increased number of unscheduled visits to the primary care physician or asthma specialist ($P = .06$), and greater age was associated with increased number of hospitalizations ($P = .03$) and fewer oral steroid courses ($P = .05$). No statistically significant associations were seen with the number of asthma attacks in the previous year, although asthma severity approached significance (Table V).

DISCUSSION

The aim of our study was to identify factors associated with asthma quality of life, asthma control and health care utilization

TABLE IV. ACQ6 and ACQ6 dichotomized at 1.00 regression analysis outcomes

Predictor	β	ACQ6			ACQ6 dichotomized at 1.00		
		95% CI	Partial R ²	P value	OR	95% CI	P value
CES-D8	0.08	0.03, 0.13	0.13	<.01			
African American race	0.79	0.20, 1.38	0.09	.02	11.68	1.31, 104.14	.03
Depression*	0.67	0.15, 1.18	0.08	.01	5.34	1.17, 24.31	.03
SF physical*	−0.02	−0.04, −0.002	0.03	.07	0.95	0.89, 1.01	.08
Age*	−0.02	−0.05, −0.003	0.03	.12			

CI, Confidence interval; OR, odds ratio.

*Data after removal of CES-D8 because of collinearity.

TABLE V. Previous 12-mo health care utilization regression analysis outcomes

Outcome	Predictor	OR	95% CI	P value
Number of attacks (0 vs 1+)	Asthma severity	2.11	0.98, 4.54	.06
	Atopy	0.03	0.003, 0.40	<.01
Hospitalizations (0 vs 1+)	Age	1.21	1.02, 1.42	.03
	FEV ₁ %	0.94	0.90, 0.99	.02
Unscheduled visits (0 vs 1+)	Atopy	0.133	0.034, 0.516	<.01
	Living situation	3.245	0.937, 11.232	.06
Oral steroid courses (0 vs 1+)	Atopy	0.22	0.06, 0.86	.03
	Age	0.88	0.77, 1.00	.05

CI, Confidence interval; OR, odds ratio.

measures in older adults with asthma. The results of this study indicate that both quality of life (mAQLQ) and asthma control (ACQ6) were affected negatively in those with higher CES-D8 scores, as well as self-reported depression. In addition, worse overall functional status was correlated with poorer asthma quality of life, and subjects who lived alone were more likely to have unscheduled visits to a physician's office.

This research gives further support for the association between depression and asthma, and specifically demonstrates this association with asthma quality of life and asthma control in the elderly population. Depression has been well documented as an associated or contributing factor of poorer control outcomes for asthma in younger age groups, as well as other chronic medical conditions,²⁷ and has been implicated in having additive adverse effects on functional status and well-being.²⁸

During data analysis, CES-D8 scores were overwhelmingly associated with poorer quality of life (mAQLQ) and control (ACQ6), supporting a strong relationship between this particular comorbidity and poorer asthma outcomes in older adults. Previous studies have demonstrated increased mortality rates in those with lower quality-of-life scores, indicating a need for improving factors that may affect this particular outcome.²⁹ Self-reported depression was also associated with both outcomes, reinforcing this conclusion. Objective measures of asthma control, including spirometric and exhaled nitric oxide results, were not found to be predictors for asthma quality of life or control, suggesting that these factors may not be as influential as they are in younger populations.

Furthermore, the risk of depression in the elderly increases with other illnesses and particularly when functionality is limited. Estimates of major depression in older people living in the community range from less than 1% to about 5%, but rises to 11% to 13% in elderly requiring significant health support.³⁰ As a part of our study, we also found that poorer functional status, both physical and mental, as measured by the 12-item SF health

survey, was associated with poorer asthma quality of life in our elderly population. This data support results from a previous study, in which SF-36 scores were significantly worse in elderly patients with asthma than in healthy controls.¹¹ Our study builds upon these results and was able to demonstrate a clear association between poorer functional status and lower quality of life.

Our study also demonstrated that current living situation may be associated with health care utilization, demonstrating a greater odds of unscheduled visits to either a primary care physician or asthma specialist if the subject lived alone (odds ratio 3.245, $P = .06$). Previous studies have shown similar associations with increased rate of ER visits for adults with asthma³¹ and increased rate of hospitalizations in elderly asthmatic patients who live alone.³² The isolated elderly are significantly more vulnerable because of fewer resources and lack of social support and are more likely to manage their chronic conditions by using various strategies to remain independent.³³ For this reason, it is important for the physician to consider living situation as a part of the standard evaluation of an older adult with asthma.

Additional and notable findings in our study included associations between the presence of atopy, younger age and higher FEV₁% with decreased health care utilization. Although atopy has been perceived as waning with increasing age, several studies have demonstrated persistence into late adulthood.^{4,34,35} We found a high percentage of subjects with atopy (77%) in our study, corroborating these previous findings. Interestingly, our data suggest that atopic older asthmatic adults are less likely than their non-atopic counterparts to have unscheduled doctors' visits, ER visits or need for oral steroids. There are two possibilities that may explain these findings. Atopic individuals may be more likely to have regularly scheduled visits for symptom evaluation, and are, therefore, not as commonly lost to follow-up. Another possible explanation to the health care usage disparity is the possibility of phenotypic differences within our population.

Some studies have documented non-atopic, neutrophil-predominant asthma patients as less responsive to corticosteroid-based therapies³⁶ and may explain more frequent exacerbations and health care utilization. No particular association was seen between objective measures of lung function (FEV₁/FENO) and asthma quality of life or control. Previous studies have demonstrated similar findings, where quality-of-life scores predicted health care utilization more accurately than did objective respiratory control data.^{37,38}

Limitations in this present study include being a single-centre study, having a relatively small sample size with female and Caucasian predominance and subjects with above-average baseline education level, which limits generalisability of the results to the elderly population. Data used for analysis were based solely on self-reporting, and medical records were not used to confirm responses. In addition, although characteristic associations were identified, causality cannot be inferred in a cross-sectional study. A larger prospective evaluation of older adults with asthma would be beneficial to confirm these findings in the asthmatic elderly population and to impart treatment options targeted to the observations.

Our results have identified both self-reported depression and depression as determined by a screening tool to have a very strong association with poorer quality of life and asthma control in older adults with asthma. Other predictors of poorer outcomes unique to this population include living alone and decreased overall functional status. With an increasing age of the general and asthmatic population, there has been greater interest in optimising the evaluation, monitoring, treatment and counselling of older adults with asthma. This study suggests that a more integrative approach is needed in older adults with asthma, with treatment of not only the physical aspects of asthma but the psychological and social aspects as well.

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