

Effect of age on asthma control: results from the National Asthma Survey

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Background: Two million US citizens older than 65 years have asthma, but little is known about asthma control in this population.

Objective: To compare short- and long-term asthma control in elderly (≥ 65 years old) and young adult (18–64 years old) populations from the National Asthma Survey.

Methods: Data from the National Asthma Survey (sponsored by the Centers for Disease Control and Prevention) were analyzed. Demographic variables, health insurance status, smoking status, indoor allergen exposure, and asthma education were compared between the young adult and elderly populations. Asthma control was examined based on short-term measures (recent oral corticosteroid bursts or symptoms) and long-term measures (asthma attacks, urgent care visits, hospitalizations, and activity limitation in the previous year).

Results: A total of 2,557 young and 398 elderly asthmatic patients were included. Elderly patients had a lower income, were less educated, were more obese, were more insured, had less indoor exposure, and were more likely to be former smokers. They were less educated about asthma attack interventions and asthma action plans ($P < .05$ for both). On multivariate analysis, elderly patients had worse control of asthma based on short-term measures (daytime symptoms in the previous month [odds ratio (OR), 1.73; 95% confidence interval (CI), 1.25–2.35] and any short-term measure [OR, 1.48; 95% CI, 1.11–1.97]) and long-term measures (activity limitation in the previous year [OR, 1.50; 95% CI, 1.12–2.01]).

Conclusions: Elderly asthmatic patients have worse short- and long-term asthma control compared with the young adult population. Further studies are needed to elucidate whether these findings are due to pathophysiologic differences and whether tailored education or other novel strategies can provide better asthma control.

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INTRODUCTION

Asthma is a major public health problem in the United States, affecting individuals across the age spectrum from infants to older adults. Physicians and patients often erroneously believe that asthma is a disease that affects only children or that all asthma begins in childhood. However, some authors^{1,2} have reported that up to 40% of people with asthma have their first attack after the age of 40 years. Although much research and public attention has focused on children and young adults, there has been little research on older adults (> 65 years) with asthma.³ In fact, many asthma trials^{4–7} have routinely excluded participants older than 65 years.

It is estimated that approximately 2 million adults older than 65 years in the United States carry a diagnosis of asthma. Older asthmatic patients shoulder a disproportionate burden of health care use and mortality, accounting for more than 1 million hospital days and more than 50% of asthma fatalities annually.^{8,9} Despite the high burden of health care utilization

and medical care costs, asthma in older adults remains poorly perceived, poorly recognized, and suboptimally treated.^{10–12}

Asthma control is considered one of the strongest independent predictors of disease-specific quality of life and general health.¹³ The current National Asthma Education and Prevention Program Expert Panel Report 3 guidelines expand the concept of asthma control as a goal of asthma management.¹⁴ The objective of this study was to examine short- and long-term asthma control in the elderly population (≥ 65 years old) compared with the young adult population (18–64 years old) from the National Asthma Survey (NAS).

METHODS

This study was approved by the Wayne State University institutional review board. Data from the 2003 NAS was used for analysis. This survey is sponsored by the National Center for Environmental Health, part of the Centers for Disease Control and Prevention. The NAS is a random-digit-dial household telephone survey conducted by the National Center for Health Statistics. The NAS is designed to produce national prevalence estimates of adults and children with asthma; to describe the health, socioeconomic, behavioral, and environmental predictors that relate to better control of asthma; and to characterize the content of care and limitations of persons with asthma.¹⁵

Oral telephone consent for study participation was obtained from NAS respondents immediately on determining

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that at least 1 person with asthma lived in the household. Respondents were informed about the voluntary nature of the survey, the authorizing legislation, and the confidentiality of data collected by the interviewers. Further details regarding survey construction and administration have been published elsewhere.¹⁶

The NAS was designed to examine detailed characteristics and behaviors of asthma-positive persons through use of the 4-state sample, which includes data from Alabama, California, Illinois, and Texas. These states were selected for detailed questioning by the Centers for Disease Control and Prevention because they provided a good geographic mix. Participants for the survey were randomly selected. The sampling period for this survey was from March 1, 2003, through March 10, 2004. The survey contains approximately 160 questions, of which 114 related to asthma and the remaining to survey eligibility and demographics. This study included respondents from the NAS who were 18 years or older and currently had asthma. Current asthma was defined as respondents who answered “yes” to the following questions: “Have you ever been told by a doctor or other health professional that you have asthma?” and “Do you still have asthma?”

Demographic variables analyzed included age, sex, income, race, education, body mass index (BMI [calculated as weight in kilograms divided by height in meters squared]), health insurance status, smoking status, indoor allergen exposure, and asthma education characteristics. The BMI was calculated from self-reported weight and height and then was transformed to underweight (<18.5), normal weight (18.5–24.9), overweight (25.0–29.9), and obese (≥30.0) categories.¹⁶ Asthma education characteristics were analyzed based on the answers to the following questions: “Has a doctor or health care professional ever taught you how to recognize early signs or symptoms of an asthma episode?” “Has a doctor or other health professional ever taught you what to do during an asthma episode or attack?” “Has a doctor or other health professional ever taught you how to use a peak flow meter to adjust daily medications?” and “Has a doctor or

other health professional ever given you an asthma management plan?”

Asthma control was divided into short- and long-term measures (Table 1). Daytime asthma symptoms in the previous 30 days were divided into 2 categories: well controlled (defined as ≤8 days in the previous month with symptoms) and uncontrolled (defined as >8 days in the previous month with symptoms). Eight days of symptoms per month was used to distinguish well-controlled from uncontrolled asthma because current guidelines define well-controlled asthma as the presence of symptoms for 2 days or less per week.¹⁴ Nighttime symptoms were similarly categorized as well controlled (≤2 nights per month with symptoms) or uncontrolled (>2 nights per month with symptoms).¹⁴ For short- and long-term control measures, we also assessed “any measure of poor control,” indicating any poorly controlled response to individual short- and long-term control measures.

Data were analyzed using a statistical software program (SPSS version 17.0; SPSS Inc, Chicago, Illinois), and comparisons were made using χ^2 tests and multiple logistic regression. Univariate analysis was performed on the 4-state sample for demographic characteristics. Bivariate analysis was performed to identify associations between age and demographic characteristics, between age and asthma education characteristics, and between age and the short- and long-term asthma control variables. Multivariate logistic regression analysis was conducted to identify odds ratios (ORs) for effect of age on asthma control variables while controlling for demographic and asthma education characteristics of the study population. Independent variables used in multiple logistic regression analysis included sex, income (≤\$25,000 or >\$25,000), race (Hispanic, white non-Hispanic, or black non-Hispanic), health insurance status, smoking status (never, former, or current), BMI (underweight, normal weight, overweight, or obese), indoor allergen exposure (mold or pets), and asthma education characteristic (early asthma attack intervention, use of a peak flow meter to adjust medications, and availability of an asthma action plan).

Table 1. Definitions of Short- and Long-term Measures of Asthma Control

Asthma control measure	Definition
Short-term	
Asthma symptoms in past week	>2 d in the previous week with symptoms
Uncontrolled daytime symptoms	>8 d in the previous month with symptoms
Uncontrolled nighttime symptoms	>2 nights in the previous month with symptoms
Exacerbations requiring oral corticosteroid therapy	Any asthma exacerbation requiring oral corticosteroid therapy in the previous 3 mo
Any measure of poor short-term control	Any 1 of the previous 4 short-term measures present
Long-term	
Asthma attack in the previous 12 mo	Episodes of asthma symptoms limiting activity or necessitating medical care in the previous 12 mo
Urgent care visits in the previous 12 mo	Any urgent care or emergency visits for asthma in the previous 12 mo
Hospitalized for asthma in the previous 12 mo	Any hospitalizations for asthma in the previous 12 mo
Limitation of activity in the previous 12 mo	Any moderate to severe limitation of usual activities due to asthma in the previous 12 mo
Any measure of poor long-term control	Any 1 of the previous 4 long-term measures present

RESULTS

Demographics

The 4-state sample of the NAS included 5,741 respondents. The age of 11 respondents was missing, and they were excluded. The 2,003 respondents younger than 18 years were also excluded. Of the remaining respondents, 772 denied having current asthma. A total of 2,955 respondents identified as having current asthma and being 18 years and older were included for analysis in this study. Of these respondents, 398 were elderly (age ≥ 65 years) and 2,557 were young adults (age 18–64 years).

Several demographic features were different between the 2 groups (Table 2). Elderly asthmatic patients were more likely to be white, to have lower incomes, to have less school education, to be overweight or obese, and to have health insurance. Compared with the young adult population, they had less household exposure to an indoor mold, a pet, or passive smoking in the previous 30 days. They were also more likely to be former smokers than current smokers.

Table 2. Characteristics of Adults From the National Asthma Survey by Age Group

Characteristic	Patients, No. (%)		P value
	Age ≥ 65 y (n = 398)	Age 18–64 y (n = 2,557)	
Sex			
Male	115 (28.9)	764 (29.9)	.72
Female	283 (71.1)	1,793 (70.1)	
Race			
Hispanic	27 (7.1)	297 (11.9)	.03 ^a
White, non-Hispanic	286 (75.5)	1,744 (70.0)	
Black, non-Hispanic	42 (11.1)	307 (12.3)	
Other	24 (6.3)	145 (5.8)	
Income: $\leq$ \$24,999	152 (53.5)	555 (25.9)	<.001 ^a
Education: ≥ 12 y, high school graduate	187 (48.1)	1,604 (63.9)	<.001 ^a
BMI: overweight/obese	268 (70.5)	1,571 (65.1)	.002 ^a
Insurance status: yes	386 (97.0)	2,122 (83.2)	<.001 ^a
Exposure			
Mold	26 (6.6)	305 (12.0)	.002 ^a
Indoor pet	130 (32.7)	1,317 (51.5)	<.001 ^a
Cockroach	46 (11.6)	319 (12.5)	.61
Smoke	51 (12.8)	608 (23.8)	<.001 ^a
Smoking status			
Never	192 (48.5)	1,449 (56.8)	<.001 ^a
Former	182 (46.0)	600 (23.5)	
Current	22 (5.6)	502 (19.7)	
HCP explained about			
ESOA	230 (59.6)	1,793 (71.3)	<.001 ^a
EAAI	267 (67.4)	2,036 (80.3)	<.001 ^a
PFM	225 (57.7)	1,519 (59.8)	.42
AAP	84 (22)	683 (27.2)	.03 ^a

Abbreviations: AAP, asthma action plan; BMI, body mass index; EAAI, early asthma attack intervention; ESOA, early signs of asthma; HCP, health care professional; PFM, peak flow meter.

^a Statistically significant.

Comparing asthma education characteristics, older adults were less likely to be educated by a physician or health care professional regarding early signs of asthma attack ($P < .001$) and early asthma attack intervention ($P < .001$) and had less availability of an asthma action plan ($P = .03$). There was no difference in the awareness of use of a peak flow meter to adjust medications between the 2 groups ($P = .42$).

Short-term Measures of Asthma Control

On bivariate analysis, multiple measures indicating poorer short-term asthma control in older adults were found, including asthma symptoms in the previous week, uncontrolled daytime asthma symptoms in the previous 30 days, and any measure indicating poor short-term asthma control ($P < .001$ for all) (Table 3). There was no difference between older and younger adults regarding nighttime symptoms in the previous 30 days or oral corticosteroid use for exacerbation in the previous 3 months.

On multivariate analysis, older adults had more uncontrolled daytime symptoms in the previous 30 days and were more likely to report any measure of poor short-term control were than younger adult (Table 3). The ORs for these comparisons ranged from 1.48 to 1.74 and were statistically significant. Older adults were also more likely to have asthma symptoms in the previous week (OR, 1.64), although the 95% confidence interval (CI) just crossed 1 (0.99–2.69).

Long-term Measures of Asthma Control

On bivariate analysis of long-term measures of asthma control, a greater proportion of older adults reported increased overnight hospitalization ($P = .002$) and moderate to severe limitation of usual activities ($P < .001$) due to asthma in the previous year (Table 4). Compared with the older adult population, the young adult population reported more asthma attacks ($P = .009$) and was more likely to have urgent care or emergency visits for asthma in the previous 12 months ($P = .03$).

Multivariate logistic regression analyses controlling for the aforementioned independent variables continued to demonstrate worse asthma control in older adults for moderate to severe limitation of activity in the previous 12 months (adjusted OR, 1.504; 95% CI, 1.125–2.011) (Table 4). The older adult population reported fewer urgent care visits for asthma, which also continued to remain significantly associated with age on multivariate analysis (adjusted OR, 0.581; 95% CI, 0.381–0.885). The other long-term control measures did not remain statistically significant on multiple logistic regression.

DISCUSSION

Analysis of the 4-state sample of the NAS demonstrated significant differences between older and young adult populations in short- and long-term measures of asthma control. These findings persisted after controlling for several demographic variables, including sex, race, socioeconomic status, education, health insurance status, BMI, indoor allergen exposure, and smoking status. In addition, these findings persisted after controlling for asthma education characteristics,

Table 3. Analyses of Short-term Measures of Asthma Control by Age Group

Asthma control measure	Patients, %		P value	AOR (95% CI) ^a
	Age ≥65 y	Age 18–64 y		
Asthma symptoms in the previous week	74.0	58.9	<.001 ^b	1.638 (0.997–2.689)
Uncontrolled daytime symptoms	68.8	50.9	<.001 ^b	1.736 (1.257–2.357) ^b
Uncontrolled nighttime symptoms	36.2	39.7	.28	NA
Exacerbations requiring oral corticosteroids	7.8	7.1	.71	NA
Any measure of poor short-term control	68.3	53.4	<.001 ^b	1.476 (1.107–1.967) ^b

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; NA, not applicable.

^a The AORs are from the logistic regression analysis controlling for the following variables: sex, income (≤\$25,000 and >\$25,000), race (Hispanic, white non-Hispanic, and black non-Hispanic), health insurance status, smoking status (never, former, or current), body mass index (underweight, normal weight, overweight, or obese), indoor allergen exposure (mold and pets), and asthma education characteristic (early asthma attack intervention, use of a peak flow meter to adjust medications, and availability of an asthma action plan).

^b Statistically significant.

including availability of an asthma action plan, peak flow meter, and knowledge about early asthma attack intervention.

Because current National Asthma Education and Prevention Program Expert Panel Report 3 guidelines suggest the importance of asthma control,¹⁴ we chose to compare asthma control between older and young adult populations in this study. Asthma control can be divided into short- and long-term control measures, and control of both domains is important.^{14,17,18} In this study, we included all short- and long-term measures available from the NAS database.

This study demonstrates significant differences between the older and young adult populations, with older adults having worse short-term asthma control, including increased frequency of symptoms in the previous week, increased daytime symptoms in the previous month, and presence of any measure indicating poor short-term control. Older adults also showed a slightly higher requirement for systemic corticosteroid therapy in the previous 3 months (7.8 vs 7.1; although not statistically significant). Previous smaller studies^{7,19–25} have also demonstrated the effect of age on asthma control. In a study of 50 older adults by Quadrelli and Roncoroni,²¹ elderly patients showed a higher requirement for systemic corticosteroid therapy and shorter symptom-free periods during the year. Similar to the present study, Wolfenden et al²³

also showed that oral corticosteroid use was higher in older adults, although this did not reach statistical significance. This study was conducted with 38 older adults who were hospitalized in the previous year. A larger study with 554 older adults by Diette et al²⁶ also reported that older patients had a greater frequency of asthma-related symptoms. However, both of these studies^{23,26} used older adults enrolled in managed care. In contrast, the present study is a large population study taken from a national survey that is a more representative sample of the geriatric population.

The long-term measures of asthma control analyzed in this study showed worse asthma control in older adults regarding moderate to severe limitation of activity in the previous 12 months. Similar results were found in the study by Diette et al,²⁶ in which elderly patients were more likely to report interference with normal activities because of asthma. The present study also found that older adults reported fewer visits to the emergency department for urgent treatment of asthma but were more likely to report asthma hospitalization. However, after accounting for confounding variables, the results did not remain significant for asthma overnight hospitalization. Similar to the present study, others have demonstrated that the young adult population is more likely to visit the emergency department for an asthma attack; however,

Table 4. Analyses of Long-term Measures of Asthma Control by Age Group

Asthma control measure	Patients, %		P value	AOR (95% CI) ^a
	Age ≥65 y	Age 18–64 y		
Asthma attack in the previous 12 mo	61	68	.009 ^b	0.789 (0.581–1.071)
Urgent care visits in the previous 12 months	17.1	22.3	.03 ^b	0.581 (0.381–0.885) ^b
Hospitalized for asthma in the previous 12 mo	12.2	7	.002 ^b	1.280 (0.738–2.217)
Limitation of activity in the previous 12 mo	41.7	30.3	<.001 ^b	1.504 (1.125–2.011) ^b
Any measure of poor long-term control	66.3	66.7	.88	NA

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; NA, not applicable.

^a The AORs are from logistic regression analysis controlling for the following variables: sex, income (≤\$25,000 and >\$25,000), race (Hispanic, white non-Hispanic, and black non-Hispanic), health insurance status, smoking status (never, former, or current), body mass index (underweight, normal weight, overweight, or obese), indoor allergen exposure (mold and pets), and asthma education characteristic (early asthma attack intervention, use of a peak flow meter to adjust medications, and availability of an asthma action plan).

^b Statistically significant.

they tend to be less frequently hospitalized.^{19,26} Quadrelli and Roncoroni²¹ demonstrated higher hospitalization rates in older adults compared with young adults, although it did not remain statistically significant on multivariate analysis. In addition, overnight hospitalizations were found to be statistically significantly higher in the elderly patients in a large prospective study by Banerji et al.¹⁹

The present study found that older adults were less likely to receive asthma education provided by a health care professional, including education about early signs of asthma, early asthma attack intervention, and availability of an asthma action plan. Also we found that availability of an asthma action plan was low in older and young adults but lower in older adults (22% vs 27%; $P = .03$). Similar results were found in a previous study by Hartert et al²⁷ suggesting that only 28% of asthmatic patients were given asthma action plans in the event of acute asthma exacerbation. Self-management strategies have been shown to improve knowledge, quality of life, asthma control, and lung function and to decrease missed work and unscheduled physician visits.^{28–31} However, there is no comprehensive asthma self-management intervention that has been tailored to individuals older than 65 years.

The present study also reports significant differences in demographic characteristic between the older and young adult populations. Older adults were found to be more likely to be overweight or obese compared with the young adult population, which is associated with increased prevalence and severity of asthma.³² We also found that elderly patients had decreased indoor allergen exposure regarding mold, pet, and smoke compared with the young adult population. We controlled for all these factors in the analysis to compare asthma control between the older and young adult populations. The data on the role of allergy in elderly asthmatic patients are conflicting. Several studies^{10,33,34} have demonstrated an increased prevalence of elevated IgE and antigen specific IgE levels in older patients, whereas several other studies^{1,2} have demonstrated no association with age.

Asthma in the elderly is a poorly studied, growing chronic disease that is underdiagnosed and undertreated.^{7,9,11,26,35,36} The death rate attributable to asthma is 14 times higher for persons 65 years and older compared with those aged 18 to 35 years, with 89.8 deaths vs 6.3 deaths per million, respectively.³⁷ Similarly, older adults are hospitalized at more than twice the rate of younger adults.³⁷ The difference in asthma control found between the older and young adult populations in the present study and in several previous studies could be affected by physiologic changes attributed to age. Also, underperception of bronchoconstriction in older adults may be responsible for the delay in seeking medical care, and decreased efficacy of emergency bronchodilation may lead to increased overnight hospitalization during an acute asthmatic episode.^{19,21,22,24}

The present study does have limitations. First, as with all cross-sectional studies, cause-and-effect relationships cannot be established. Second, findings from this study are based on

self-report and are subject to recall bias. Another limitation in this study is that the survey did not evaluate for comorbidities present in older adults. It is known that older adults are more likely to report comorbid conditions that could also present as symptoms similar to those of asthma.^{7,9,11,26,35} Similarly, the treatment modalities available for asthma cannot be fully used in older adults because of the greater probability of adverse effects in the setting of multiple comorbidities and problems with effective drug delivery.^{38,39} Sleep apnea, cardiovascular risks, depression, and psychosocial factors, such as social isolation, have been linked to the morbidity and mortality of asthma.^{40,41} However, the national survey did not evaluate these factors. Previous studies^{26,42} have suggested that asthma symptoms might mimic other comorbidities in elderly populations. Further future studies addressing these limitations should be conducted.

In summary, this analysis of the NAS demonstrates that elderly patients have elements of worse short- and long-term control of asthma compared with the young adult population. These differences persisted after controlling for several confounding variables. Further studies are needed to elucidate whether these findings are due to pathophysiologic differences attributed to age and whether a tailored education program, novel medications, or other strategies can be helpful in better controlling asthma in this population.

REFERENCES

1. Burrows B, Barbee RA, Cline MG, Knudson RJ, Lebowitz MD. Characteristics of asthma among elderly adults in a sample of the general population. *Chest*. 1991;100:935–942.
2. Braman SS, Kaemmerlen JT, Davis SM. Asthma in the elderly: a comparison between patients with recently acquired and long-standing disease. *Am Rev Respir Dis*. 1991;143:336–340.
3. Chan ED, Welsh CH. Geriatric respiratory medicine. *Chest*. 1998;114:1704–1733.
4. Wood PR, Smith B, O'Donnell L, et al. Quantifying asthma symptoms in adults: the Lara Asthma Symptom Scale. *J Allergy Clin Immunol*. 2007;120:1368–1372.
5. Sin DD, Man SF. Low-dose inhaled corticosteroid therapy and risk of emergency department visits for asthma. *Arch Intern Med*. 2002;162:1591–1595.
6. Deykin A, Wechsler ME, Boushey HA, et al. Combination therapy with a long-acting beta-agonist and a leukotriene antagonist in moderate asthma. *Am J Respir Crit Care Med*. 2007;175:228–234.
7. Stupka E, deShazo R. Asthma in seniors, part 1: evidence for underdiagnosis, undertreatment, and increasing morbidity and mortality. *Am J Med*. 2009;122:6–11.
8. Moorman JE, Rudd RA, Johnson CA, et al. National Surveillance for Asthma—United States, 1980–2004. *MMWR Surveill Summ*. 2007;56:1–54.
9. Braman SS, Hanania NA. Asthma in older adults. *Clin Chest Med*. 2007;28:685–702.
10. Enright PL, McClelland RL, Newman AB, Gottlieb DJ, Lebowitz MD. Underdiagnosis and undertreatment of asthma in the elderly: Cardiovascular Health Study Research Group. *Chest*. 1999;116:603–613.
11. Busse PJ, Kilaru K. Complexities of diagnosis and treatment of allergic respiratory disease in the elderly. *Drugs Aging*. 2009;26:1–22.
12. Parameswaran K, Hildreth AJ, Chadha D, Keaney NP, Taylor IK, Bansal SK. Asthma in the elderly: underperceived, underdiagnosed and undertreated: a community survey. *Respir Med*. 1998;92:573–577.

13. Chen H, Gould MK, Blanc PD, et al. Asthma control, severity, and quality of life: quantifying the effect of uncontrolled disease. *J Allergy Clin Immunol.* 2007;120:396–402.
14. National Asthma Education and Prevention Program. Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007. *J Allergy Clin Immunol.* 2007;120(suppl):S94–S138.
15. National Center for Health Statistics. *State and Local Area Integrated Telephone Survey: National Asthma Survey.* Hyattsville, MD: National Center for Health Statistics; 2003.
16. O'Connor KS, Osborn L, Olson L, et al. Design and operation of the National Asthma Survey. *Vital Health Stat 1.* 2008;(46):1–122.
17. Humbert M, Holgate S, Boulet LP, Bousquet J. Asthma control or severity: that is the question. *Allergy.* 2007;62:95–101.
18. Koshak EA. Classification of asthma according to revised 2006 GINA: evolution from severity to control. *Ann Thorac Med.* 2007;2:45–46.
19. Banerji A, Clark S, Afilalo M, Blanda MP, Cydulka RK, Camargo CA Jr. Prospective multicenter study of acute asthma in younger versus older adults presenting to the emergency department. *J Am Geriatr Soc.* 2006;54:48–55.
20. Weiner P, Magadle R, Waizman J, Weiner M, Rabner M, Zamir D. Characteristics of asthma in the elderly. *Eur Respir J.* 1998;12:564–568.
21. Quadrelli SA, Roncoroni AJ. Is asthma in the elderly really different? *Respiration.* 1998;65:347–353.
22. Kizkin O, Turker G, Hacievliyagil SS, Gunen H. Asthma, age, and early reversibility testing. *J Asthma.* 2003;40:317–321.
23. Wolfenden LL, Diette GB, Skinner EA, Steinwachs DM, Wu AW. Gaps in asthma care of the oldest adults. *J Am Geriatr Soc.* 2002;50:877–883.
24. Bellia V, Cibella F, Cuttitta G, et al. Effect of age upon airway obstruction and reversibility in adult patients with asthma. *Chest.* 1998;114:1336–1342.
25. deShazo RD, Stupka JE. Asthma in US seniors, part 2: treatment: seeing through the glass darkly. *Am J Med.* 2009;122:109–113.
26. Diette GB, Krishnan JA, Dominici F, et al. Asthma in older patients: factors associated with hospitalization. *Arch Intern Med.* 2002;162:1123–1132.
27. Hartert TV, Windom HH, Peebles RS Jr, Freidhoff LR, Togias A. Inadequate outpatient medical therapy for patients with asthma admitted to two urban hospitals. *Am J Med.* 1996;100:386–394.
28. Griffiths C, Foster G, Barnes N, et al. Specialist nurse intervention to reduce unscheduled asthma care in a deprived multiethnic area: the east London randomised controlled trial for high risk asthma (ELECTRA). *BMJ.* 2004;328:144.
29. Ignacio-Garcia JM, Pinto-Tenorio M, Chocron-Giraldez MJ, et al. Benefits at 3 yrs of an asthma education programme coupled with regular reinforcement. *Eur Respir J.* 2002;20:1095–1101.
30. Janson SL, Fahy JV, Covington JK, Paul SM, Gold WM, Boushey HA. Effects of individual self-management education on clinical, biological, and adherence outcomes in asthma. *Am J Med.* 2003;115:620–626.
31. Schermer TR, Thoonen BP, van den Boom G, et al. Randomized controlled economic evaluation of asthma self-management in primary health care. *Am J Respir Crit Care Med.* 2002;166:1062–1072.
32. Weiss ST. Obesity: insight into the origins of asthma. *Nat Immunol.* 2005;6:537–539.
33. King MJ, Bukantz SC, Phillips S, Mohapatra SS, Tamulis T, Lockey RF. Serum total IgE and specific IgE to *Dermatophagoides pteronyssinus*, but not eosinophil cationic protein, are more likely to be elevated in elderly asthmatic patients. *Allergy Asthma Proc.* 2004;25:321–325.
34. Rogers L, Cassino C, Berger KI, et al. Asthma in the elderly: cockroach sensitization and severity of airway obstruction in elderly nonsmokers. *Chest.* 2002;122:1580–1586.
35. Barua P, O'Mahony MS. Overcoming gaps in the management of asthma in older patients: new insights. *Drugs Aging.* 2005;22:1029–1059.
36. Busse PJ. Allergic respiratory disease in the elderly. *Am J Med.* 2007;120:498–502.
37. Centers for Disease Control and Prevention (CDC). Asthma mortality and hospitalization among children and young adults: United States, 1980–1993. *MMWR Morb Mortal Wkly Rep.* 1996;45:350–353.
38. Weatherall M, Clay J, James K, Perrin K, Shirlcliffe P, Beasley R. Dose-response relationship of inhaled corticosteroids and cataracts: a systematic review and meta-analysis. *Respirology.* 2009;14:983–990.
39. Chotirmall SH, Watts M, Branagan P, Donegan CF, Moore A, McElvaney NG. Diagnosis and management of asthma in older adults. *J Am Geriatr Soc.* 2009;57:901–909.
40. Harrison BD. Psychosocial aspects of asthma in adults. *Thorax.* 1998;53:519–525.
41. Wainwright NW, Surtees PG, Wareham NJ, Harrison BD. Psychosocial factors and asthma in a community sample of older adults. *J Psychosom Res.* 2007;62:357–361.
42. Baptist AP, Deol BB, Reddy RC, Nelson B, Clark NM. Age-specific factors influencing asthma management by older adults. *Qual Health Res.* 2010;20:117–124.

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