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Factors Associated with Asthma Control among Adults in Five New England States, 2006–2007

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Background. Despite the National Asthma Education and Prevention Program (NAEPP) guidelines that specify the goals of asthma control and management strategies, the number of patients with uncontrolled asthma remains high, and factors associated with uncontrolled asthma are unknown. *Objective.* The aim was to examine the relationship between asthma control and socio-demographic characteristics, health-care access and use, asthma education, and medication use among adults with active asthma residing in New England. *Methods.* Data from the 2006–2007 Behavior Risk Factor Surveillance System Adult Asthma Call-Back Survey were analyzed using multinomial logistic regression. Asthma control was categorized as "well controlled," "not well controlled," or "very poorly controlled" according to the NAEPP guidelines. *Results.* Of the respondents ($n = 3079$), 30% met the criteria for well-controlled asthma, 46% for not well-controlled asthma, and 24% for very poorly controlled asthma. Being of Hispanic ethnicity (odds ratio [OR] = 4.0; 95% confidence interval [CI] = 1.2–13.7), unemployed or unable to work (OR = 17.9; 95% CI = 6.0–53.4), high school educated or less (OR = 2.8; 95% CI = 1.6–4.7), current smokers (OR = 2.5; 95% CI = 1.3–5.1), or being unable to see a doctor or specialist for asthma care or unable to buy medication for asthma because of cost (OR = 7.6; 95% CI = 3.4–17.1) were associated with very poorly controlled asthma. In addition, having Coronary Obstructive Pulmonary Disease (COPD) (OR = 2.6; 95% CI = 1.5–4.5), two or more routine checkups for asthma (OR = 4.5; 95% CI = 2.3–8.9), or an emergency department visit, urgent care facility visit, and hospitalization in the past year (OR = 3.9; 95% CI = 2.1–7.3) were also associated with having very poorly controlled asthma. Using controller medication in the past year (OR = 2.6; 95% CI = 1.6–4.2) and taking a course on how to manage asthma (OR = 3.0; 95% CI = 1.2–7.8) were significantly associated with poor asthma control. *Conclusion.* The high prevalence (70%) of not well-controlled asthma and poorly controlled asthma in this study emphasizes the need to identify factors associated with poor asthma control for development of targeted intervention. A health policy of increasing asthma education, health-care access, and smoking cessation may be effective and result in better asthma control and management.

Keywords access to health care, asthma, cross-sectional study, education, socio-demographic factors

INTRODUCTION

Asthma is one of the most common chronic conditions in the United States. It affects more than 20 million people in the United States, including 7.1 million children (1). In 2007, an estimated 8.3% of US adults were told by a physician that they "currently have asthma"; 13.1% had been told at some point in their life that they "have asthma" (2). Asthma was responsible for approximately 14 million physician office visits, 1.4 million hospital outpatient discharges, 2 million emergency department visits, 450,000 asthma hospitalizations, and 3500 deaths in 2007 (3–5). The total cost for asthma was estimated at $56 billion due to medical and productivity losses in 2007 (6). Uncontrolled asthma contributes to an increase in asthma symptoms, medication use, physician office visits and ED visits, and missed days of school and work (7). Most asthma costs can be attributed to uncontrolled asthma symptoms, with 80% of the direct costs distributed among approximately 20% of patients with difficult-to-control asthma (8, 9). The estimated annual cost for patients with difficult-to-control asthma was more than $2500 per patient, while the cost was only $140 per patient for other asthma patients (9).

The 2007 National Asthma Education and Prevention Program (NAEPP) guidelines define asthma control based on current impairment (e.g., symptoms, sleep disturbances, limitation of daily activities, and use of rescue medication) and future risk (e.g., asthma exacerbations, progressive decline in lung function in adults or reduced lung growth in children, or treatment-related adverse effects) (10). Despite the NAEPP guidelines that specify the goals of asthma control and asthma management strategies, previous studies have shown that asthma is not well controlled in most patients (11, 12).

Several studies have examined the factors associated with asthma control. While Schatz et al. (13) found that health-care access and use was associated with poorer asthma control, Vogt et al. (14) and Bloomberg et al. (15) identified socio-economic factors (e.g., low income

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and Medicaid insurance) as important variables. Overall, epidemiologic studies suggest that health-care access and use, smoking status, poor adherence to doctor's advice, critical errors in inhaler use, oral corticosteroid use, and lack of regular specialist care are significant factors associated with poor asthma control (16–20). Having Coronary Obstructive Pulmonary Disease (COPD) a higher body mass index (BMI), gastroesophageal reflux, low income, and other than Caucasian ancestry are also significant factors associated with poor asthma control (16–20). However, most of these studies were conducted among patients with a high prevalence of poor control and may not be representative of the total asthma population.

While previous studies suggest that patient characteristics may be significant predictors of control, no study has examined these factors among the general population using NAEPP guidelines for asthma control. Previous studies were conducted in high-risk groups, such as those in an intervention program to reduce asthma, in specialty practice, in a Medicaid plan, or in randomized controlled trials (13–21). In addition, previous studies were inconsistent in their definitions of asthma control and did not necessarily follow NAEPP guidelines (13–21). A literature gap exists on factors and patient characteristics (e.g., socio-economic status, ethnicity, health insurance status, presence of comorbidities, and current smoking) that could predict individual responses to asthma therapies among the general population and therefore asthma-related health outcomes.

New England has a higher asthma prevalence rate (9.7%) than the other regions of the United States combined (8.1%), after controlling for gender, age, race/ethnicity, income, education, and marital, overweight, and smoking status (22). The reasons for these higher prevalence rates remain unknown, which further emphasizes the need for understanding asthma risk factor roles in this region. A better understanding of modifiable risk factors can help improve asthma management and prevent asthma exacerbations. We examined the relationship between different factors and asthma control in a sample of adults with active asthma among New England residents using the 2006–2007 Behavioral Risk Factor Surveillance System (BRFSS) Asthma Call-Back Survey (ACBS) data.

METHODS

BRFSS Survey Design

The BRFSS is the largest ongoing telephone survey in the world that has been conducted by the Centers for Disease Control and Prevention and state health departments since 1984. This nationally representative survey is administered in all 50 states, the District of Columbia, and US territories. The survey collects information about modifiable risk factors for chronic diseases and other leading causes of death among the non-institutionalized US population aged ≥18 years annually. The BRFSS uses a disproportionate, stratified sampling plan for selecting a nationally representative sample (2). This survey design has been detailed elsewhere (23). Estimates from the BRFSS have been found to be reliable and valid (24, 25); BRFSS data are widely analyzed by researchers and the results are published in peer-reviewed journals (26).

Data Collection

Interviewers undergo standard training, follow uniform procedures for data collection, and receive refresher training courses on an annual basis (27). Supervisors are responsible for ensuring that interviewers conduct quality interviews, adhere to protocol oversee, and accurately collect data (27). Two weeks after the annual BRFSS survey was conducted, a follow-up ACBS was administered to respondents who responded "yes" to the question "Have you ever been told by a doctor, nurse, or other health professional that you had asthma?" The ACBS contains questions that cover a wide range of topics including detailed information about demographic factors, health-care use, asthma self-education and management, medication, symptoms, quality of life, and other factors associated with asthma (28). A complete list of the questions is available online (28). Many of the questions in the ACBS have been used in national surveys (e.g., The National Asthma Survey and The National Health Interview Survey) (29). Definitions for asthma cases in questionnaires have been validated in previous studies by testing the questionnaire in relation to a clinical physiologic investigation, comparing the answers from the questionnaire with a clinical diagnosis of asthma and comparing a new questionnaire with an old one (25). Because of the repeated use of asthma-related measures in national surveys, general agreement among researchers and the logical relations among several questions demonstrate face and construct validity (30).

Following the guidelines in the NAEPP Expert Panel Report 3 (10), we classified asthma control as well controlled, not well controlled, and very poorly controlled by using four parameters: daytime symptoms, nighttime symptoms, interference with normal activity, and use of short-acting β_2-agonists (SABA) (Table 1). This is a modified version of the 2007 NAEEP guidelines because it does not include pulmonary function measures. Symptoms were defined as recurrent episodes of coughing,

TABLE 1.—Classification of asthma control modified from the National Asthma Education and Prevention Program Expert Panel Report 3 guidelines.

Impairment	Well controlled	Not well controlled	Very poorly controlled
Symptoms	≤2 days/week	>2 days/week	Throughout the day
Nighttime awakenings	≤2/month	1–3/week	≥4/week
Interference with normal activity	None	Some limitation	Extremely limited
Short-acting β_2-agonists	≤2 days/week	>2 days/week	Several times/day

wheezing, shortness of breath, or chest tightness. Some limitations to physical activity were defined as "a little" or "a moderate amount" of activity limitations due to asthma (i.e., exercise, other physical activity, and attendance at work or school). Cost as a barrier is defined as being unable to see a doctor or specialist for asthma care or unable to buy medication for asthma in the past year because of cost.

In addition to the asthma control questions, the BRFSS included questions on age, sex, race, Hispanic ethnicity, BMI, metropolitan area residence, educational level, employment status, smoking status, depression, and comorbidities such as COPD. All of the six New England states except Rhode Island conducted the ACBS in 2006 and 2007.

Statistical Analysis

BMIs (kg/m^2) were categorized as $<$25.0 (underweight or normal), 25.0–29.9 (overweight), and $\geq$30.0 (obese) (2). An urban area was classified as a metropolitan statistical area according to the U.S. Census (31). Education was categorized as high school (HS) graduate or less, some college or technical school, or college graduate. Employment status was categorized as employed, homemaker/student, retired, or unable to work. Current smokers were defined as persons who had smoked at least 100 cigarettes in their lifetime and currently smoked, either occasionally or every day. Measured comorbidities included COPD and physician-diagnosed depression.

Health-care access and use were determined by whether respondents were covered by health insurance and had seen a doctor within the past year because of their asthma. These doctor visits for asthma could include a routine checkup, an ED visit, a doctor visit for an urgent asthma attack or worsening asthma symptoms, or an overnight stay in a hospital. Cost of care was assessed by whether the respondents had ever been unable to see a doctor or buy medication for their asthma because of cost. Receiving asthma self-management education was determined if the respondent was ever taught by a health-care professional how to recognize early signs or symptoms of an asthma attack, what to do during an asthma attack, or how to use a peak flow meter to adjust their daily medications. Respondents also were asked whether they had ever been given a written asthma action plan and whether they had ever taken a course on how to manage asthma. Medications included any controller medication use in the past 3 months. Controller medication variable was created if respondents reported using any prescription long-term control medications (e.g., corticosteroids, cromolyn sodium and nedocromil, long-acting beta agonist, leukotriene receptor antagonists, immunomodulators, and methylxanthines) in the past 3 months (10).

Based on the Council of State and Territorial Epidemiologists' (CSTE) recommendation of "probable" case definition of asthma for surveillance, respondents were considered to have active asthma if they reported in the past 12 months any of the following: having seeing a doctor or other health-care provider about asthma, taken any asthma medications, or experienced any asthma symptoms (32–34). For the rest of this article, the word "respondents" refers to survey respondents who met the criteria for active asthma.

Weighted analyses were conducted using SAS version 9.2 (SAS Institute, Inc., Cary, NC, USA) to account for the complex sampling design to represent adult population in the corresponding New England states (35). Factors considered in the weighing process included the probability of selection of a telephone number, the number of adults in a household, and the number of telephones in a household. Non-response and non-coverage of households without telephones were also adjusted for in the final post-stratification.

Descriptive statistics (e.g., means and percentages) were performed with PROC SURVEYMEANS and PROC SURVEYFREQ. Chi-square tests were used to evaluate any differences in demographic characteristics (e.g., age, sex, race/ethnicity, education, employment status, BMI, residence in metropolitan area), COPD, depression, and smoking status. Also evaluated were health-care access and use (e.g., health insurance, routine checkup for asthma, ED visit, urgent care facility visit, hospitalization, cost as a barrier), knowledge of asthma self-management, and medications used for asthma control. Variables that were found to be significant ($p < .05$) factors of asthma control in a bivariate analysis were included in the multinomial logistic regression model. Although age and race were not significant factors of asthma control in univariate analysis, we included those variables in the model because they are known confounders.

Relative standard error [RSE] (RSE = SE/prevalence estimate) and sample size of 50 for denominator (requirement for BRFSS data) were used to test the reliability of our findings (36, 37). If the RSE was less than 0.30, estimates were considered to be reliable. None of the estimates in our analysis were found to be unreliable according to the RSEs.

RESULTS

Sample Population Characteristics

Of the 3079 respondents in New England, 30% met the criteria for well-controlled asthma, 46% for not well-controlled asthma, and 24% for very poorly controlled asthma (Table 2). Most of the respondents were of non-Hispanic white ancestry (86%); 65% of the respondents were female. Forty-three percent were college graduates, 59% were employed, and the average age was 44 years. The respondents' BMIs were almost equally distributed among the three BMI categories: underweight or normal (35%), overweight (31%), and obese (34%). More than 80% of the respondents lived in a metropolitan area. Sixteen percent were current smokers, 27% had COPD, and 34% had depression.

TABLE 2.—Socio-economic and demographic characteristics and health conditions by level of asthma control.

Characteristics	*n* (%)	Level of asthma control		
		Well controlled	Not well controlled	Very poorly controlled
Total	3079 (100.0)	819 (30.4%)	1369 (45.6%)	891 (23.9%)
Age (years)				
18–24	102 (12.3)	24.7	53.8	21.5
25–34	279 (21.0)	31.2	48.5	20.4
35–44	483 (16.7)	35.2	47.4	17.4
45–54	731 (20.9)	30.7	44.5	24.7
55–64	748 (14.9)	31.6	37.8	30.6
≥65	715 (14.5)	26.5	42.6	30.8
Gender				
Male	813 (34.7)	33.8	41.4	24.8
Female	2266 (65.3)	28.7	47.9	23.5
Race/ethnicity				
Non-Hispanic white	2737 (85.7)	32.6	44.3	23.1
Non-Hispanic black	52 (2.0)	11.2	71.8	17.0
Hispanic	135 (8.5)	17.1	50.5	32.4
Other	122 (3.8)	20.5	54.7	24.8
Employment**				
Employed for wages/self-employed	1608 (58.5)	36.1	44.9	18.9
Homemaker/student	223 (11.4)	30.9	61.3	7.9
Retired	641 (13.0)	29.4	39.9	30.7
Unemployed/unable to work	603 (17.1)	12.2	40.6	47.2
Education**				
High school graduate or less	1034 (31.7)	17.6	46.3	36.2
Some college or technical school	788 (24.8)	25.2	49.9	24.9
College graduate	1256 (43.4)	42.8	42.7	14.5
Metropolitan area				
Yes	1841 (83.8)	30.0	46.3	23.7
No	1238 (16.2)	32.8	42.2	25.0
Body mass index*				
Normal/underweight	906 (34.7)	31.3	47.6	21.1
Overweight	917(31.1)	36.8	43.8	19.4
Obese	1108 (34.2)	25.3	44.8	29.9
Have COPD**	1124 (26.9)	15.6	39.9	44.5
Current smoking**				
Yes	542 (15.9)	14.2	47.7	38.2
No	2520 (84.1)	33.7	45.4	20.9
Depression*				
Yes	1119 (33.8)	23.5	46.6	29.9
No	1915 (66.2)	33.7	45.2	21.1

Notes: Percentages are weighted. Percentages may not add to 100 due to rounding.
P-values: *$p < .05$; **$p < 0.001$.

Most respondents had health insurance coverage (91%) (Table 3). However, 41% had no annual routine checkups for asthma, and 13% were unable to see a doctor or specialist for asthma care or buy medication for asthma in the past year because of cost. More than one-fourth (27%) of the respondents reported having an ED visit, urgent care facility visit, or hospitalization in the past year. Almost 40% of the respondents reported using controller medications in the past 3 months.

Seventy-nine percent of the respondents had been taught what to do during an asthma attack and 66% had been taught early signs or symptoms of an asthma attack. Forty-eight percent of the respondents had been taught how to use a peak flow meter to adjust daily medications; 29% had been given a written asthma action plan; and 6% had taken a course on how to manage asthma. Overall, 89% of the respondents reported receiving any self-management education.

Bivariate and Multivariate Results

The respondents' levels of asthma control were significantly ($p < .05$) associated with their employment, education, BMI, smoking status, COPD, and depression (Table 2). In addition, asthma control was significantly ($p < .05$) associated with all factors related to health-care access and use (Table 3). Respondents who had been taught how to use a peak flow meter to adjust daily medications, had been given a written asthma action plan, or had taken a course on how to manage asthma compared with those who had not reported a higher percentage in very poorly controlled asthma. In addition, respondents who used controller medications in the past year compared with those who had not used controller medications in the past year reported a higher percentage in very poorly controlled asthma.

TABLE 3.—Health-care access and use, self-management education, and medication use according to asthma control.

		Level of asthma control		
	n (%)	Well controlled	Not well controlled	Very poorly controlled
Health-care access and use				
Health insurance*	2882(91.4)	31.6	46.5	21.9
Routine checkup for asthma**				
None	1239(41.4)	38.8	48.3	12.9
One	758(29.8)	34.0	41.6	24.4
Two or more	1037(28.8)	14.7	45.8	39.5
ER visit, urgent care facility visit, or hospitalization in the past year**	857(26.7)	15.2	42.9	41.9
Cost as a barrier**	402(12.7)	5.4	44.7	49.9
Self-management education				
Taught signs or symptoms of an asthma episode	1946(66.4)	28.4	47.8	23.7
Taught what to do during an asthma episode	2349(79.3)	29.4	45.3	25.3
Taught how to use a peak flow meter to adjust daily medications**	1396(47.7)	24.6	46.6	28.8
Been given an asthma action plan**	850(29.1)	19.3	48.8	31.9
Taken a course on how to manage asthma**	265(6.3)	14.1	41.7	44.2
Any self-management education	2689(89.1)	28.8	46.7	24.5
Medication use				
Controller medication use**	1420(39.6)	20.5	47.1	32.3

Notes: Percentages are weighted. Percentages may not add to 100 due to rounding.
P-values: *$p < .05$; **$p < .0001$.

In a multinomial logistic model, socio-demographic factors, health-care access and use, self-management education, and medication use were associated with poor asthma control (Table 4). Hispanic ethnicity was associated with very poorly controlled asthma (OR = 4.0; 95% CI = 1.2–13.7). Compared with homemakers and students, retired respondents were 3.8 times more likely (95% CI = 1.2–11.8) to have very poorly controlled asthma; employed respondents were 4.5 times more likely (95% CI = 1.7–12.4); and unemployed or unable to work respondents were 17.9 times more likely (95% CI = 6.0–53.4). Compared with college graduates, HS graduate respondents were 1.8 times more likely (95% CI = 1.1–3.1) to have not well-controlled asthma and were 2.8 times more likely (95% CI = 1.6–4.7) to have very poorly controlled asthma. Current smokers were 2.5 times more likely (95% CI = 1.3–5.1) than non-smokers to have very poorly controlled asthma; respondents with COPD were 2.6 times more likely (95% CI = 1.5, 4.5) than respondents without these conditions to have very poorly controlled asthma.

Having two or more routine checkups for asthma in the past year was significantly associated with not well-controlled asthma (OR = 2.3; 95% CI = 1.2–4.2) and very poorly controlled asthma (OR = 4.5; 95% CI = 2.3–8.9). Having an ED visit, urgent care facility visit, or hospitalization in the past year was associated with very poorly controlled asthma (OR = 3.9; 95% CI = 2.1–7.3). Being unable to see a doctor or specialist for asthma care or buy medication for asthma because of cost was associated with not well-controlled asthma (OR = 4.7; 95% CI = 2.3–9.5) and very poorly controlled asthma (OR = 7.6; 95% CI = 3.4–17.1). Having taken a course on how to manage asthma was significantly associated with very poorly controlled asthma (OR = 3.0; 95% CI = 1.2–7.8). Respondents who used controller medication in the past year were 1.7 times more likely (95% CI = 1.1–2.5) to have not well-controlled asthma, and 2.6 times more likely (95% CI = 1.6–4.2) to have very poorly controlled asthma compared with respondents who had not used controller medications.

DISCUSSION

The purpose of this population-based study was to assess asthma control status and identify potential risk factors for suboptimal asthma control among respondents with active asthma in New England. Similar to a report by the Asthma Regional Council (22), this study showed that 70% of the respondents with active asthma had very poorly controlled/not well-controlled asthma. Also consistent with previous study findings (23), smoking and having less than a HS education were associated with poor asthma control. Similar to results by Williams et al. (19) and Adams et al. (20), this study showed that the level of health-care access and use and self-management education were reflected in the degree of asthma control. In particular, poor asthma control was associated with an increase in ED visits or hospitalization in the past year. Although 91% of the population reported having insurance, underinsurance may be contributing to poor asthma control as evidenced by our finding that 13% of our respondents reported cost as a barrier to seeking health care. Similar to previous studies, respondents who reported an economic barrier to seeing

TABLE 4.—Multivariate analysis of the relationship between selected characteristics with level of asthma control.

Demographics	Adjusted odds ratios (95% CI)	
	Not well controlled	Very poorly controlled
Age (years)		
18–24	1.0	1.0
25–34	0.7 (0.3–1.9)	0.6 (0.2–2.2)
35–44	0.7 (0.3–1.6)	0.5 (0.2–1.5)
45–54	0.7 (0.3–1.6)	0.6 (0.2–1.7)
55–64	0.6 (0.2–1.4)	0.8 (0.2–2.3)
≥65	0.7 (0.3–1.8)	1.1 (0.3–3.7)
Gender		
Male	1.0	1.0
Female	1.3 (0.9–2.1)	1.1 (0.7–1.9)
Race/ethnicity		
Non-Hispanic white	1.0	1.0
Non-Hispanic black	2.6 (0.9–7.8)	0.9 (0.2–3.7)
Hispanic	2.1 (0.9–4.9)	4.0 (1.2–13.7)
Other	1.4 (0.3–7.2)	1.4 (0.3–6.2)
Employment		
Employed for wages/self-employed	1.1 (0.5–2.2)	4.5 (1.7–12.4)
Homemaker/student	1.0	1.0
Retired	1.0 (0.5–2.4)	3.8 (1.2–11.8)
Unemployed/unable to work	2.0 (0.8–4.8)	17.9 (6.0–53.4)
Education		
High school graduate or less	1.8 (1.1–3.1)	2.8 (1.6–4.7)
Some college or technical school	1.6 (1.0–2.6)	1.9 (1.0–3.5)
College graduate	1.0	1.0
Have COPD (Y/N)	1.2 (0.8–2.0)	2.6 (1.5–4.5)
Current smoking (Y/N)	2.0 (1.0–3.7)	2.5 (1.3–5.1)
Depression (Y/N)	0.9 (0.6–1.4)	0.8 (0.5–1.4)
Health-care access and use		
Health insurance (Y/N)	1.5 (0.7–3.4)	0.4 (0.2–1.1)
Routine checkup for asthma		
None	1.0	1.0
One	0.9 (0.6–1.4)	2.1 (1.1–3.7)
Two or more	2.3 (1.2–4.2)	4.5 (2.3–8.9)
ER visit, urgent care facility visit, or hospitalization in the past year (Y/N)	1.7 (0.9–3.0)	3.9 (2.1–7.3)
Cost as a barrier (Y/N)	4.7 (2.3–9.5)	7.6 (3.4–17.1)
Self-management education(Y/N)		
Taught how to use a peak flow meter to adjust daily medications	1.0 (0.6–1.5)	0.9 (0.5–1.6)
Given an asthma action plan	1.6 (1.0–2.6)	1.6 (0.9–2.7)
Taken a course on how to manage asthma	1.4 (0.7–2.8)	3.0 (1.2–7.8)
Medication use (Y/N)		
Controller medication use	1.7 (1.1–2.5)	2.6 (1.6–4.2)

Notes: Generalized logit model for nominal responses (multinomial logit model) with "well controlled" as reference category. "No" category is the reference group for all "yes/no" variables.

a doctor or cost barrier to getting asthma medications were significantly more likely to have poor asthma control (19, 20). Subsequently, inadequate medication and preventative medical services resulting in poor asthma control may have led to higher numbers of urgent care facility visits in our population (38). These results suggest socio-economic factors resulting in inadequate health-care access and utilization can play a significant role in asthma management and control.

Asthma self-management education is necessary to provide persons with asthma and caregivers with the knowledge and skills to control and manage asthma (39, 40). For example, the lack of written asthma action plans has been associated with increased use of acute health-care services (39). In our study, respondents reported low self-management education; only 6% of the respondents with active asthma reported taking a course on how to manage asthma, which is less than the Healthy People 2010 target for this objective of 30% (41). According to NAEPP guidelines, all persons with asthma should have the education and management skills to identify and control their asthma symptoms effectively. These results indicate a need for increased use of written action plans as well as asthma self-management education in this population.

Although using long-term, single, or combination controller medication is needed to achieve and maintain asthma control effectively (38, 39), only 40% of the

respondents with active asthma in New England reported using controller medications. This rate is much lower than the previously reported rate for the US population (40). Clinical interventions should focus on understanding reasons for the infrequent use of controller medications in this population as well as determining a treatment regimen that patients will adhere to.

One of the strengths of our study is that it encompasses individuals in the general population without regard to asthma severity level, insurance status, or utilization of health-care services. This allows us to reach a hard-to-reach population of individuals who may not have health insurance and may have milder cases of asthma. However, a potential concern of this study is the relatively low response rates, ranging from 37% to 76%, which is common for national telephone studies (42). The bias from non-response can change the OR in either direction—whether persons who refused to respond would have answered the questions approximately the same as respondents is impossible to determine. However, the data were weighted to ensure that results were consistent with population data and population estimates for respondents with active asthma in the New England states. Therefore, the findings from this study may not be generalized to US residents not living in New England.

In addition, because this is a cross-sectional study, the observed associations do not imply causality, and we cannot establish a definitive temporal sequence of events. For example, respondents who took a course on how to manage asthma were 3 times more likely to have very poorly controlled asthma than respondents who had not taken a course. This finding is likely because respondents with very poorly controlled asthma had chosen to take a course on how to manage asthma in more instances than respondents with better asthma control. Future longitudinal studies should be conducted to determine the association between higher rates of asthma education and management among respondents with poorer asthma control.

Finally, the criteria to define the level of asthma control in this study were based on some, but not all, of the requirements in the NAEPP guidelines. Lung function data were not collected and, hence, could not be included as a criterion for asthma control for this report. The NAEPP guidelines stress the importance of measuring several variables in the assessment of asthma, including frequency and severity of past exacerbations and symptoms, with pulmonary function measures only as an additional guide (10). It is common/standard practice in survey research for cases to be defined by self-report and subjective measures, whereas in clinical settings it is more likely to be defined by objective measures such as lung function and subjective measures (symptoms). Since the purpose of survey is not to provide a medical care, consistent with the other studies, we used only self-reported symptoms to define asthma control status (16–19). The exclusion of lung function as an asthma control measure in survey research is not without precedence and our findings are similar to those of other studies that have used modified NAEPP guidelines to categorize asthma control without the inclusion of lung function data (15).

Conclusion/Key Findings

Despite national guidelines for asthma control and available current treatments, most respondents with active asthma in New England have uncontrolled asthma; they either do not receive adequate education for self-management of asthma or may receive it after an asthma episode occurs. This study suggests that poor asthma control is highly associated with potentially modifiable risk factors, especially educational level, smoking status, and self-management education. The results also illustrate racial/ethnic and socio-economic disparities in poorer asthma control, such as being Hispanic, being unemployed, and having a HS degree or less increase the odds of having poor asthma control. Even after controlling for factors related to the utilization of primary care services and controller medications, factors related to socio-economic status were still statistically associated with poorer asthma control. This suggests that public health efforts toward increasing asthma control could benefit from targeted interventions that have the potential to improve asthma care and quality-of-life as well as address disparities in asthma morbidity among specific subgroups of people who are disporportionately at risk.

Identifying modifiable risk factors for poor asthma control may guide public health efforts for effective asthma control and management. Preventative measures such as providing self-management education to all respondents with asthma may reduce hospitalizations, ED visits, and health-care costs. Establishing a combination of medical and behavioral interventions to increase asthma self-management education and access to health care, and decrease smoking rates is an important step in improving asthma management and control among adults with active asthma.

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Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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