



Modifiable factors associated with severe asthma exacerbations in urban patients

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ABSTRACT

Background: Rates of asthma morbidity, mortality, and resource use are highest among African American individuals residing in inner-city locations, yet factors associated with adverse outcomes are not well established.

Objective: To identify modifiable factors associated with asthma exacerbations.

Methods: A total of 104 adult patients who presented to an inner-city hospital or emergency department (ED) with an asthma exacerbation from October 1, 2009, through June 31, 2010, completed surveys of clinical status, acute events, sociodemographic characteristics, current asthma knowledge, self-efficacy, attitudes toward asthma self-management, and perceived barriers to asthma care questionnaires. Associations with asthma hospitalizations and ED visits were assessed.

Results: The mean age of the patients was 42 years, 91% were African American, 33% were insured, 57% were taking a controller medication, and 63% had an income level below the federal poverty line. On bivariate analysis, males, years of asthma, history of smoking, self-classification of asthma severity, history of admission to intensive care unit or intubation, use of peak flow meter or asthma action plan, controller medication use, and history of oral corticosteroid bursts were positively associated, whereas self-efficacy was negatively associated with number of ED visits or hospitalizations. No association was found for asthma knowledge, perceived barriers to care, or attitudes toward asthma management. On multivariate analysis, low self-efficacy remained associated with both asthma hospitalizations and ED visits.

Conclusion: Short-term use of health services for asthma is negatively associated with asthma self-efficacy. Self-management programs that enhance self-efficacy, rather than those that focus on knowledge or attitudes, may be effective in reducing adverse asthma outcomes for inner-city, predominantly African American populations.

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Introduction

Asthma is a common and costly public health problem in the United States, affecting approximately 34.1 million Americans during their lifetime, with an annual cost of \$34 billion.^{1–3} Rates of asthma morbidity, mortality, and resource use are highest among inner-city populations.⁴ Among these, African Americans within urban areas have significantly higher rates of both asthma mortality and health care use than whites.^{1,4,5} A recent report from the Centers for Disease Control and Prevention found that African Americans were 4.5 times more likely to have an emergency department (ED) visit and were 3 times more likely to die of asthma-related causes than the whites.¹ Unfortunately, little progress has been made in decreasing the hospi-

talization or relapse rate for asthma in urban areas with predominantly African American populations.

Asthma exacerbations and hospitalizations in many different populations have been associated with various factors. Some of these factors may be difficult to modify, such as pollution,⁶ temperature/humidity,⁷ and aeroallergens levels.^{8–11} However, there are other factors associated with adverse asthma outcomes that are modifiable, such as asthma knowledge,¹² perceived barriers to care,^{11,13,14} asthma self-efficacy,^{10,15–19} attitudes toward asthma,¹⁶ and lack of an asthma action plan.^{16,20} To our knowledge, no study has attempted to assess which of these factors is most influential on severe asthma exacerbations in urban areas with a predominantly African American population.

Determining which modifiable patient-level factors are associated with adverse asthma control will provide targets for future interventional trials. The objective of this study was to evaluate the influence of demographic data along with asthma clinical features, knowledge, self-efficacy, attitudes, and perceived barriers to care on number of hospitalization and ED visits in the inner city with a predominantly African American population.

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Methods

A prospective, cross-sectional study was conducted in the ED and inpatient wards of Detroit Receiving Hospital and Harper University Hospital, 2 tertiary care teaching hospitals affiliated with Wayne State University. Data were collected from October 1, 2009, through June 31, 2010, from a convenience sample of patients presenting to the ED or hospital with a chief symptom of an asthma exacerbation. We intentionally administered the survey during an exacerbation because patients might be most reflective on their illness at that time. This study was approved by the Wayne State University institutional review board.

Patients were eligible to participate if they had a history of physician-diagnosed asthma, were older than 18 years, and were English speaking. Patients were excluded if they had a history of chronic obstructive pulmonary disease (COPD), a greater than 20 pack-year smoking history (to exclude patients likely to have COPD),²¹ or mental impairment such that completion of the survey or institutional review board consent would not be possible. Written informed consent was obtained from all eligible patients. After enrollment, patients completed the survey either in person (for those who were hospitalized or could complete the survey in the ED) or on the telephone (for patients who were discharged from the ED before the survey could be administered).

Demographic data, asthma clinical features, and health care use information were obtained. Demographic data included age, sex, race, highest educational level, body mass index, insurance status, employment status, median household income, and smoking status. Asthma clinical features included self-classification of asthma (mild, moderate, or severe), years of diagnosis of asthma, oral corticosteroid use in prior year, history of intensive care unit (ICU) admission or intubation, availability of an asthma specialist, triggers of current exacerbation, indoor allergen exposure (pet, mold, or cockroach), social support (presence of friends or family who assisted in asthma management), and use of a controller medication. Health care use was assessed by the self-reported number of ED visits and hospitalizations for asthma during the past year.

Validated questionnaires were used to assess the current asthma knowledge,²² self-efficacy,²³ attitudes toward asthma self-management,²⁴ and perceived barriers to asthma care.¹⁴ Current asthma knowledge was assessed with the 12-item Consumer Asthma Questionnaire developed by Kritikos et al.²² Response categories of the questionnaire were true or false. One point was allocated to each correct answer and zero for each incorrect answer or each question that was left unanswered for the maximum possible score of 12. Attitudes toward asthma self-management were assessed with the 20-item attitude subscale of the Knowledge, Attitude, and Self-Efficacy scale developed by Wigal et al.²⁴ Each of these 20 questions is answered on a 5-point Likert scale. The maximum score a patient can attain on the attitude subscale is 100. The higher an individual's score, the more positive the individual's attitude regarding his or her asthma and the more the person is willing to work in cooperation with a physician to manage the illness.

Asthma self-efficacy was assessed by using the 11-item Perceived Control of Asthma Questionnaire developed by Katz et al.²³ Individuals were asked to respond to each item using a 5-point Likert scale. Responses were scored from 1 to 5 for each of the 11 items, yielding a possible score range of 11 to 55. A lower score indicated the perception of less control over one's asthma. The validated 39-item Barriers to Care Questionnaire developed by Seid¹⁴ was used to assess the barriers to care perceived by the inner-city patients with asthma. The Barriers to Care Questionnaire yields a score ranging from 0 to 100. Higher scores denote fewer perceived barriers.

Presence of asthma education provided by a health care professional was based on answering yes to either of the following ques-

tions: "Has a doctor or other health professional ever taught you how to use a peak flow meter to adjust daily medications?" or "Has a doctor or other health professional ever given you an asthma management plan?" These questions were adopted from the National Asthma Survey conducted by the Centers for Disease Control and Prevention.²⁵ Finally, patients who believed that they only had asthma when they had symptoms were identified using the following question: "Do you think you have asthma all of the time or most of the time or some of the time or only when you are having symptoms?" These patients are referred as "no symptom, no asthma." This question has previously been used to identify patients who do not think about or manage their asthma as a chronic disease and subsequently have worse outcomes.²⁶ The entire survey took approximately 45 minutes to complete. Because of a high known rate of illiteracy in this patient population, every question was individually read by the research staff, who then marked the answers on the questionnaire.

Data were analyzed using SPSS statistical software, version 17.0 (SPSS Inc, Chicago, Illinois), and comparisons were made using χ^2 and multivariate linear regression. The χ^2 analysis was performed to identify associations between health care use and demographic characteristics and health care use and asthma clinical characteristics. Next, multivariate linear regression analysis with backward selection was conducted to identify factors associated with health care use, while controlling for demographic, asthma clinical features, and asthma education characteristics of the study population. Independent variables used in multiple linear regression analysis included all demographic and asthma clinical features with a $P < .20$ on χ^2 analysis.

Results

Demographic characteristics

Of 133 individuals identified as eligible for enrollment in the study, completed survey responses were received from 104 (78.2%). The demographic characteristics of the population are listed in Table 1. Notably, 91% of the participants were African American, 63% had an income level below the federal poverty line, 53% had a smoking history, and 33% did not have insurance. All these characteristics are representative of the patient population

Table 1
Demographic characteristics of the study population^a

Characteristic	No. (%) of patients (N = 104)
Age, mean (SD), y	42.7 (13.4)
Male	38 (35.9)
Race	
White	4 (3.8)
Black	95 (91.3)
Other	5 (4.8)
Ever smoked	55 (53.4)
Educational level (high school or less)	83 (80.6)
Income (<\$10,000)	63 (63)
Body mass index	
Normal	27 (26.2)
Overweight	15 (14.6)
Obese	60 (58.3)
Has a primary care physician	65 (63.7)
Self-reported indoor allergen exposure	
Pet	22 (21.4)
Cockroach or mold	17 (16.5)
Employment status	
Full time	20 (19.2)
Part time	9 (8.7)
Not employed	75 (72.1)
Have social support	79 (79)
Have insurance	69 (67)

^aData are represented as number (percentage) of patients unless otherwise indicated.

Table 2
Asthma clinical features of the study population

Feature	No. (%) of patients ^a
Self-classification of asthma	
Mild	20 (19.8)
Moderate	26 (25.7)
Severe	55 (54.5)
Has an asthma specialist	21 (20.6)
Duration of asthma, y	
<10	19 (18.4)
10–25	32 (31.1)
25–40	27 (26.2)
>40	25 (24.3)
Use controller medication	58 (56.9)
Ever been to ICU or intubated	58 (56.3)
Have PFM or AAP	77 (75.5)
No symptom, no asthma belief	14 (14.3)
Oral corticosteroid use	
Use in prior year	90 (86.5)
Mean (SD) No. of courses	4.77 (4.9)

Abbreviations: AAP, asthma action plan; ICU, intensive care unit; PFM, peak flow meter.

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

served by the 2 inner-city, university-based hospitals participating in the study.

Asthma clinical characteristics

Fifty-five percent reported their asthma as severe on the asthma self-classification scale (Table 2). Fifty-six percent had either been intubated or been to an ICU at least once in their lives. Twenty-six percent had been to the ICU without being intubated. Forty-three percent were not using any controller medication, and 86.5% had required a course of oral corticosteroids for an asthma exacerbation in the prior year. The mean (SD) number of hospitalizations and ED visits in the prior year were 3.12 (3.48) and 5.74 (6.09), respectively.

The mean asthma knowledge score was 7.39, where the maximum possible score was 12 (Table 3). On assessment of barriers to care, the mean score was 73.6 (a higher score indicates fewer perceived barriers) of a maximum possible score of 100. The mean attitude toward asthma management score was 77.7 (a higher score represents a more positive attitude regarding asthma and a greater likelihood to work in cooperation with a physician to manage the illness) of a maximum possible score of 100. The mean self-efficacy score was 36.8 (a higher score indicates a greater sense of control over one's asthma), and the range of possible scores on this scale was 11 to 55. Table 3 compares the possible ranges, current study scores, and values from previously published literature using this questionnaire. As noted, the mean values of this study were all slightly lower than the values from previously published literature.

Factors associated with health care use

Multiple variables were associated with ED visits or admissions to the hospital in the prior year on bivariate analysis (Table 4). Male sex, years of asthma, history of smoking, self-classification of asthma severity, history of admission to ICU or intubation, use of peak flow meter or asthma action plan, controller medication use,

Table 3
Mean asthma scores

Scale	Possible range	Previously published mean (SD)	Study mean (SD)
Asthma knowledge	0–12	8.20 (1.89) ²²	7.39 (1.6)
Barriers to care	0–100	86.32 (14.09) ¹⁴	73.6 (19.5)
Attitude	20–100	82 (8) ⁴¹	77.7 (7.8)
Self-efficacy	11–55	38.8 (6.7) ²³	36.8 (6.4)

Table 4
Factors associated with hospitalizations or ED visits (bivariate linear analysis)

Variable	Factors
Hospitalization	Sex ^a Duration of asthma ^a Ever smoked ^a Self-classification of severity ^a Ever in ICU or intubated ^a PFM or AAP ^a Self-efficacy score ^a Controller use ^a Oral corticosteroid use ^a Asthma specialist
ED visit	Sex Educational level Self-efficacy score ^a Oral corticosteroid use ^a PFM or AAP
Hospitalization or ED visit	Sex BMI Duration of asthma Self-classification of severity Ever in ICU or intubated ^a Have insurance ^a Oral corticosteroid use ^a Asthma specialist PFM or AAP Social support

Abbreviations: AAP, asthma action plan; BMI, body mass index; ED, emergency department; ICU, intensive care unit; PFM, peak flow meter.

^a $P < .05$; for all others, $P < .20$.

and history of oral corticosteroid bursts were positively associated, whereas self-efficacy score was negatively associated. No association was found for availability of primary care physician, asthma specialist, indoor allergen exposure, household income, body mass index, social support, asthma knowledge score, barriers to care score, or attitudes toward asthma management score.

On multivariate analysis, we found that asthma hospitalizations continued to be significantly associated with a low self-efficacy score, number of courses of oral corticosteroid burst in the prior year, and history of admission to ICU or intubation (Table 5). ED visits in the prior year were found to be significantly associated with a low self-efficacy score and number of courses of oral corticosteroid burst in the prior year. The total health care use was significantly related to the number of courses of oral corticosteroid burst and history of ICU or intubation. All other factors no longer remained significant after multivariate analysis.

Table 5
Factors associated with hospitalization, ED visit, and total health care use (multivariate linear analysis)

Characteristic	β (95% CI)	P value
Hospitalization		
Ever in ICU or intubated	0.888 (−0.108 to 1.884)	.08
Self-efficacy score	−0.093 (−0.165 to −0.022)	.01
Oral corticosteroid use in prior year	0.487 (0.381 to 0.593)	<.001
ED visit		
Self-efficacy score	−0.130 (−0.229 to −0.031)	.01
Oral corticosteroid use in prior year	0.917 (0.788 to 1.046)	<.001
Hospitalization or ED visit		
Ever in ICU or intubated	1.839 (−0.276 to 3.953)	.09
Oral corticosteroid use in prior year	1.381 (1.166 to 1.596)	<.001

Abbreviations: CI, confidence interval; ED, emergency department; ICU, intensive care unit.

Discussion

Asthma exacerbations, such as ED visits and hospitalizations, have been associated with various factors. Some of these factors may be difficult to modify, whereas others may be more appropriate targets for interventions. This study identified modifiable factors for an asthma exacerbation while controlling for demographic factors, asthma clinical features, and other nonmodifiable factors. After controlling for these factors, we found that asthma self-efficacy remained associated with poor outcomes in inner-city adult patients. Self-efficacy appeared more influential than asthma knowledge, perceived barriers to care, and attitudes toward asthma management. This information is particularly useful for physicians treating African American patients to decrease the tremendous health care disparities seen in asthma. Asthma self-efficacy is defined as a patient's belief about his or her ability and capacity to accomplish asthma control or to deal with the challenges of this chronic disease.²³ Self-efficacy differs from attitudes about asthma; self-efficacy refers to a patient's perceived ability to control an illness, whereas attitude indicates a positive or negative evaluation of the disease state. Patients with greater self-efficacy may be more motivated to adhere to maintenance medication regimens, to increase the amount of effort they are willing to devote to managing their asthma, and to be more persistent when difficulties are encountered.²⁷ After controlling for multiple modifiable and non-modifiable factors, our study found that lower self-efficacy remained associated with increased asthma morbidity. Previous studies have also found a positive role of self-efficacy as a factor associated with asthma health-related outcomes.^{10,15–19,23} However, this is the first study to control for multiple modifiable factors, including perceived barriers to care, asthma knowledge, and attitudes toward asthma management.

In regard to asthma education programs, previous trials have shown mixed results in improvement of outcomes,^{12,28–34} although few of these trials have included self-efficacy training in their curriculum. Previous educational interventions that included self-efficacy as part of the curriculum typically demonstrate an added benefit and decreased asthma symptoms.^{12,35–37} However, none of these trials were performed in a predominantly African American population. Further trials are needed to determine whether these interventions can benefit inner-city, African American asthma patients with a lower socioeconomic status.

Our study found that asthma knowledge, perceived barriers to care, and attitudes toward asthma self-management were not associated with increased asthma-related health care use when controlling for other factors. Previous studies have demonstrated mixed results for these factors. Scherer and Bruce³⁸ reported lack of association of asthma knowledge with asthma morbidity, but attitudes toward asthma self-management and self-efficacy were found to be significantly associated with asthma morbidity. A study conducted by Leroyer et al³⁹ demonstrated a positive association between asthma knowledge and quality of life. Furthermore, previous trials conducted to increase patients' asthma knowledge through asthma education sessions showed varied results in terms of increasing their asthma quality of life or self-management skills.^{28,29,34}

Another factor that was not found significantly related to asthma health care use in our study was barriers to care. In a recent study performed by Seid,¹⁴ barriers to care were reported to be associated with poorer access, lower primary care quality, and worse health-related quality of life. Similar results have been demonstrated by Halm et al¹³ and Warman et al.¹¹ However, in our population the mean score on the Barriers To Care Questionnaire⁴⁰ was above 70%, indicating that most of the patients in this study did not believe that barriers to receive medical care were a significant problem with asthma management.

Attitudes toward asthma self-management have been found to be related to short-term use of health care services in a study performed with 293 inner-city adult patients with moderate to severe asthma in 2000 by Adams et al.¹⁶ Similar results were reported by Scherer and Bruce³⁸ and Mancuso et al.⁴¹ However, our study did not find an association of attitudes toward asthma self-management and asthma exacerbations or hospitalizations when controlling for other factors. A possible explanation for the difference is that these studies did not concurrently examine self-efficacy.

Previous studies have demonstrated a mixed association between health care use and lack of primary care physician,^{44,45} lack of availability of asthma action plan,^{46,47} peak flow meter use,⁴⁸ nonadherence to inhaled corticosteroid therapy,⁴⁹ and care from asthma specialists.⁵⁰ Our study did not find any correlation between these factors and asthma morbidity. Some of these factors were found to be associated with the ED visits or hospitalization on the univariate analysis (summarized in Table 4); however, these factors lost statistical significance on accounting for all the factors together on multivariate analysis (Table 5). This potentially indicates that self-efficacy can compensate for traditionally studied predictors in the prevention of adverse asthma outcomes. Also, unlike previous studies, this cohort was predominantly African American patients, perhaps accounting for the discrepancy.

The current study has some limitations. We studied a moderate-sized cohort from 2 inner-city hospitals without inclusion of a control group. The participants were predominantly African American, and although we intentionally sampled this population because of the significantly higher rates of both asthma mortality and health care use,^{1,5} the applicability to other cohorts is unclear. There was a lack of any objective confirmation of an asthma diagnosis, although we intentionally chose participants with a prior physician diagnosis to increase applicability. In fact, a study demonstrated that despite recommended guidelines, less than 50% of patient presenting with an asthma exacerbation to the ED received spirometric analysis.⁴²

The validated questionnaires have not been previously used during an acute illness. In this study, the questionnaire was provided to the patients during their acute illness, which might have affected the patient's perception of asthma knowledge, self-efficacy, attitudes, and barriers to care; hence, the mean values of this study were slightly lower than the previously published literature. However, the low mean values can also be attributed to the study population comprising predominantly low-income, urban, African American, asthmatic patients. Findings from our study are based on self-report and are subject to recall bias. In addition, our questions created a tendency for some respondents to give socially desirable responses. However, as mentioned, we intentionally administered the survey during an exacerbation so that patients might be most reflective on their illness at that time.⁴³

In conclusion, our study found that asthma self-efficacy is associated with asthma-related ED visits and hospitalizations even after controlling for other factors. Greater self-efficacy may therefore be more important than asthma knowledge, perceived barriers to care, or attitudes toward asthma self-management as a potential interventional target. Asthma management programs designed to enhance self-efficacy may be beneficial to reduce the use of acute health care services in inner-city populations.

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