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Asthma Predictors Influence on Self-management Asthma Education Status

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Objectives: The objective of this study was to determine the characteristics of adults with active asthma who were most likely to acquire self-management asthma component education. **Methods:** We analyzed adult data from the 2014 Behavioral Risk Factor Surveillance System (BRFSS)-Asthma Call-back Survey (ACBS). Multivariate logistic regression and multivariate linear regression models were used to analyze the association between asthma self-management education and predictors. **Results:** Adults who had health insurance (aB = 0.33 [SE = 0.15], p < .05), routine care visits (aB = 0.75 [SE = 0.08], p < .05) and hospitalization (aB = 0.50 [SE = 0.23], p < .05) reported higher asthma education scores. Adults aged 18-34 years were more likely to report inhaler use instruction (aOR = 3.9; 95% CI: 2.5-6.3, p < .05), than older adults aged 65 years and older. Having a formal education, being a woman, and being black increased the likelihood of having a higher self-management score. **Conclusion:** Having health insurance, making routine visits, and having asthma episodes were associated with multiple asthma education components which ensures social justice. Asthma control programs need to reexamine asthma education components to make sure they are promoted to persons regardless of their age, education level, or sex.

Key words: asthma education; adult asthma; asthma self-management; social justice
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Asthma is a chronic respiratory illness that affects over 17 million United States (US) adults.[1] For adults with asthma, self-management is critical for controlling their chronic illness, as there presently is no cure for asthma.[2-4] Not only is it essential for individuals to maintain regular visits with their primary care physician to receive asthma self-management education in consultation with an allergist or pulmonologist regarding their asthma, but it also allows individuals to be active participants in their health and may help to increase asthma control.[4-6]

Research shows that knowledge and skills associated with asthma self-management education have improved asthma outcomes when utilized prior to acute hospital visits.[6-8] Patient self-management provides asthma patients the necessary knowledge to understand asthma treatment and teaches them how to live healthy lives to reduce morbidity related issues.[9] Asthma self-management education teaches patients varied topics including how to take asthma medication properly, seek medical care as necessary, recognize the signs/symptoms of asthma attacks/episodes and to recognize and avoid environmental factors and irritants.[1-8,10] This self-management education ensures that social justice ait can reduce unplanned doctor's visits, reduced emergency room visits by half, improve quality of life, and reduce asthma related healthcare costs in the millions.[1,11,12] This reduction in unplanned visits enables primary care physicians to increase their productivity, as billions of dollars in productivity

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have been lost due to asthma related sick days.[13]

Moreover, in an aging society, understanding which components of self-management education are discussed are critical, as it appears that older adults have lower adherence to medical regimens.[14] This lack of adherence may stem from poor access to self-management education and health literacy that are normally provided by a primary care physician.[6,14] Other demographic characteristics need to be considered, ie, gender, race and ethnicity, as these are associated with how many components of self-management the individual will receive.[1,15]

Although prior studies have examined characteristics of adults living with asthma,[16,17] there has been limited research about asthma self-management components for adults living with asthma.[1] It is important to depict the multiple components of asthma education because of the multidimensional approach for asthma self-management; only then can health educators and healthcare providers improve health education delivery for adults with asthma. Hence, we examined US adults living with active asthma, their asthma education components, healthcare outcomes, and access to and use of asthma care resources.

METHODS
Data

The Behavioral Risk Factor Surveillance System (BRFSS) is a continuing random-digit survey done by telephone of noninstitutionalized adults aged 18 years and older who reside in the US. For over 3 decades, the BRFSS has reported data on health risk behaviors and preventive health practices that affect one's health status.[18] The BRFSS-Asthma Call-back Survey (ACBS) has been administered since 2005. The BRFSS survey participants who answered "yes" to the question: "Have you ever been told by a doctor, nurse or other health professional you have asthma?" participated in the BRFSS-ACBS within 2 weeks of their initial participation to provide more information regarding their asthma.

Only one adult per household was allowed to participate in the BRFSS-ACBS survey which asked questions about asthma symptoms, episodes/attacks, asthma education, healthcare access and utilization, medication use, comorbidities and environmental allergens/irritants.[19] For this study, we focused on the adults in the BRFSS-ACBS land-line-cellphone combined dataset as this study was limited to adults, and we wanted a robust sample size that was achieved from adding the combined dataset and not just the landline dataset.

Participants were categorized as having active asthma if in the last year they talked to a physician or other healthcare professional about asthma, took medication for asthma, or had asthma symptoms.[20] Overall, 12,196 participants were included in the 2014 BRFSS ACBS dataset from 30 states (Connecticut, Georgia, Hawaii, Illinois, Indiana, Iowa, Maine, Maryland, Michigan, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Vermont, Washington, West Virginia, and Wisconsin), Puerto Rico, and Washington, DC.

Of the 12,196 participants who were categorized as ever having asthma, 9813 adults were categorized as having active asthma, had valid responses to the 7 asthma self-management education component questions and had valid responses to the predictors of interest. The predictors selected were those which have been shown to have a relationship to having asthma including: gender, age, race and ethnicity, and education.[1,13-17]

Data Analysis

Table 1 reports demographics (ie, sex, age, race and ethnicity, and education) of study participants. Asthma health outcome measures (ie, 'asthma episodes' and asthma control status) and access to and use of resources were measured for our sample. Health risk factors including obesity status, current smoking status, and comorbid conditions (ie, physician diagnosed chronic obstructive pulmonary disease [COPD], emphysema, or chronic bronchitis; and depression) were included in analyses. Asthma control status was classified using the following 3 parameters: daytime symptoms, nighttime symptoms and short-acting β_2 agonists.[4,9] Participants who did not have daytime symptoms, did not have nighttime symptoms, and did not use short-acting β_2 agonists were classified as having well-controlled asthma. Participants who experienced one or 2 of the following conditions: daytime symptoms, nighttime symptoms, and use of short-acting β_2 agonists had semi-controlled asthma. Participants

Table 1
Descriptive Characteristics of Participants with Active Asthma,
Asthma Call-back Survey, 2014 (N = 9813)

Characteristics	Sample size[a]	Weighted % (95% CI)
Sex		
Male	3348	41.4 (39.1–43.8)
Female	6465	58.6 (56.2–60.9)
Age group (years)		
18-34	1379	36.7 (34.2–39.3)
35-44	1024	15.7 (13.9–17.5)
45-54	1701	16.8 (15.3–18.3)
55-64	2521	16.0 (14.7–17.3)
65+	3188	14.8 (13.7–15.8)
Race and ethnicity		
White, non-Hispanic	7621	69.7 (67.4–71.9)
Black, non-Hispanic	638	13.2 (11.3–15.0)
Hispanic	950	11.5 (9.9–13.2)
Other	604	5.7 (4.6–6.7)
Education		
Not high school graduate	734	11.3 (9.6–13.0)
High school graduate	2430	25.8 (23.6–28.0)
Some college or technical school	2882	34.3 (32.0–36.5)
College graduate	3767	28.6 (26.6–30.6)
Health risk factors (yes/no)		
Obesity	4118	39.2 (36.9–41.4)
Current smoker	1470	18.8 (16.9–20.7)
COPD[b]	2481	20.1 (18.3–21.9)
Depression	3473	35.2 (32.8–37.6)
		(continued on next page)

who had daytime symptoms, nighttime symptoms and used short-acting β_2 agonists had poorly controlled asthma.

Participants were categorized as obese [with a body mass index (BMI) of 30.0 kg/m² or higher] and not obese [<30.0 kg/m² or lower]. Smoking status was categorized as a current smoker or not a current nonsmoker. Healthcare access was determined through the following measures: health insurance status [yes/no], routine care visit (have seen a doctor for routine asthma care [yes/no]), urgent care visit (had an urgent care visit in the last 12 months because of asthma episode [yes/no]), emergency room [ER] visit (visited an ER in the past 12 months because of asthma [yes/no]), hospital-

ization (stayed overnight in a hospital because of asthma in last 12 months [yes/no]), cost as a barrier (unable to buy medication [yes/no], unable to see primary care physician [yes/no], and unable to see a specialist in the last 12 months [yes/no]).

- Asthma self-management education status was assessed by participants' responses to 7 questions:
- Has a doctor or other health professional ever taught you how to recognize early signs or symptoms of an asthma episode? [yes/no]
- Has a doctor or other health professional ever taught you how to respond to episodes of asthma? [yes/no]

Table 1 (continued)
Descriptive Characteristics of Participants with Active Asthma,
Asthma Call-back Survey, 2014 (N = 9813)

Characteristics	Sample size[a]	Weighted % (95% CI)
Asthma control levels		
Poorly controlled	1406	13.2 (11.9–14.6)
Semi-controlled	4114	40.3 (37.9–42.7)
Well controlled	4293	46.5 (44.1–48.9)
Asthma episodes in past year (yes/no)	2799	28.8 (26.8–30.9)
Healthcare access and use (yes/no)		
Health insurance	9145	88.5 (86.8–90.3)
Routine care visits	4412	38.9 (36.7–41.1)
Emergency room visits	832	7.8 (6.8–8.8)
Urgent care visits	1618	15.0 (13.5–16.4)
Hospitalization	217	1.7 (1.3–2.1)
Cost as barrier (yes/no)		
Medication cost	1094	12.0 (10.4–13.6)
Primary care physician visit costs	594	6.4 (5.3–7.6)
Specialist visit cost	368	4.9 (3.7–6.0)

Note.
'no' is the reference category for all 'yes/no' variables
CI = confidence interval; COPD = chronic obstructive pulmonary disease
a: Unweighted sample size
b: Reported having COPD, emphysema, or chronic bronchitis

- Has a doctor or other health professional ever taught you how to use a peak flow meter to adjust your daily medications? [yes/no]
- Has a doctor or other health professional ever given you an asthma management plan? [yes/no]
- Has a doctor or other health professional ever given you a course or class on how to manage asthma yourself? [yes/no]
- Has a doctor or other health professional ever showed you how to use the inhaler? [yes/no]
- Has a doctor or other health professional ever advised you to change things in your home, school, or work to improve your asthma? [yes/no]

An asthma self-management education score with 8 responses was created by counting the number of confirmatory responses to the 7 self-management asthma education questions (responses ranged from 0 to 7).

All analyses were conducted in SAS version 9.4 (SAS Institute Inc., Cary, NC). Specific SAS procedures were utilized to account for the complex survey design of the 2014 BRFSS-ACBS dataset. A multivariate logistic regression model was used to examine the association between each self-management asthma education component and the predictors. Multivariate ordinal regression was not done to assess the association between asthma education score and predictors as the proportional odds assumption was violated. As a result, multivariate multinomial regression was attempted; however, due to the large number of categories in the asthma education score outcome variable, it was determined multivariate linear regression was more appropriate to report the association between asthma education score and the predictors.

RESULTS

Among 9813 adults with active asthma, 58.6%

Table 2
Asthma Self-management Education among Participants with Active Asthma,
Asthma Call-back Survey, 2014 (N = 9813)

Components	Sample size[a]	Weighted % (95% CI)
Taught to recognize early sign and symptoms of an asthma episode	6162	64.3 (62.0–66.6)
Taught to respond to an asthma episode appropriately	7162	74.2 (72.0–76.4)
Taught how to use a peak flow meter	3952	41.4 (39.1–43.7)
Given an asthma action plan	2633	26.8 (24.8–28.9)
Taken a course on how to manage asthma	829	8.3 (6.9–9.6)
Taught how to use an inhaler	8495	87.3 (85.7–88.9)
Given advice on environmental control	3204	32.3 (30.0–34.5)
Asthma education score		
None	555	6.0 (4.7–7.4)
One	1276	11.2 (9.9–12.6)
Two	1386	13.3 (11.6–15.0)
Three	2013	21.2 (19.3–23.0)
Four	1901	20.7 (18.7–22.7)
Five	1552	16.5 (14.7–18.2)
Six	924	9.3 (8.0–10.7)
Seven	206	1.7 (1.3–2.2)

Note.
CI = confidence interval
a: Unweighted sample size

were women, 36.7% were 18-34 years old, 69.7% were non-Hispanic white, and approximately 11.3% did not graduate from high school. Approximately 40% of participants were obese, 18.8% were current smokers, 20.1% were diagnosed with COPD, and 35.2% were diagnosed with depression by a physician (Table 1).

Less than one-third of participants reported an asthma attack in the last year, 40.3% had semi-controlled asthma, and 13.2% had poorly controlled asthma. A large proportion (88.5%) of adults reported having health insurance, 38.9% had sought a routine care visit, 7.8% had gone to the emergency room, 15.0% had went to an urgent care and 1.7% had been hospitalized. Among participants, 12.0% reported cost as a barrier to buying medication for treating asthma, 6.4% indicated cost was a barrier for accessing a primary care physician, and 4.9% cost was a barrier for a specialist visit in the last year. Over three-fourth's (81.3%)

of adults who have asthma have at least one of the self-management asthma education components and over two-thirds had 3 or more components. The most common components included being taught inhaler use (87.3%), taught asthma episode response (74.2%), and being taught to recognize signs or symptoms of asthma (64.3%). Table 2 presents these data and the overall summary of self-management asthma education scores.

Table 3 presents the results of the multivariate logistic regression. Each predictor was associated with one or more self-management asthma education components except for current smoking status, COPD, emergency room visits, urgent care visits, and cost as a barrier. For being taught to recognize signs or symptoms of an asthma episode, the adjusted odds ratios were higher for adults 18-34 years old (aOR = 1.9 [95% CI: 1.4–2.6], p < .05) than for adults aged 65 years or older, and for adults with higher formal education (ie, college

Table 3
Association between Asthma Self-management Education Components and Demographic Characteristics of Participants with Active Asthma, Asthma Call-back Survey, 2014 (N = 9813)

Characteristics	Taught to recognize sign/symptoms of an episode Model 1 aOR (95% CI)	Taught to respond to an asthma episode Model 2 aOR (95% CI)	Taught how to use a peak flow meter Model 3 aOR (95% CI)	Given an asthma action plan Model 4 aOR (95% CI)	Taken asthma management course Model 5 aOR (95% CI)	Taught how to use an inhaler Model 6 aOR (95% CI)	Given advice on environmental control Model 7 aOR (95% CI)
Sex							
Male	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Female	1.1 (0.9–1.4)	1.1 (0.9–1.4)	1.2 (1.0–1.5)	1.2 (1.0–1.5)	1.1 (0.7–1.5)	1.5 (1.1–2.0)*	1.3 (1.04–1.6)*
Age group (years)							
18-34	1.9 (1.4–2.6)*	1.9 (1.3–2.8)*	1.2 (0.9–1.6)	1.3 (1.0–1.7)	1.0 (0.6–1.6)	3.9 (2.5–6.3)*	2.5 (1.8–3.4)*
35-44	1.9 (1.4–2.6)*	2.0 (1.4–2.9)*	1.3 (0.9–1.7)	1.5 (1.1–2.0)*	1.0 (0.6–1.7)	1.9 (1.2–3.1)*	2.0 (1.4–2.8)*
45-54	1.5 (1.2–2.0)*	1.5 (1.1–2.0)*	1.2 (0.9–1.5)	1.3 (1.0–1.7)	0.7 (0.5–1.1)	1.8 (1.3–2.7)*	2.3 (1.7–2.9)*
55-64	1.4 (1.1–1.8)*	1.6 (1.2–2.0)*	1.3 (1.0–1.6)	1.3 (1.0–1.6)	1.0 (0.7–1.4)	1.7 (1.3–2.3)*	1.7 (1.3–2.2)*
65+	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Race and ethnicity							
White, non-Hispanic	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Black, non-Hispanic	1.3 (1.0–1.9)	1.1 (0.8–1.6)	1.8 (1.3–2.6)*	1.1 (0.7–1.5)	2.0 (1.3–3.3)*	1.0 (0.6–1.5)	0.8 (0.6–1.1)
Hispanic	1.1 (0.8–1.5)	0.9 (0.6–1.3)	1.2 (0.8–1.8)	1.1 (0.8–1.6)	1.1 (0.6–1.9)	0.9 (0.6–1.4)	1.2 (0.8–1.8)
Other	0.9 (0.6–1.4)	0.8 (0.5–1.2)	1.7 (1.1–2.5)*	0.9 (0.6–1.4)	1.6 (0.9–2.7)	1.0 (0.6–1.7)	1.1 (0.7–1.6)
Education							
Not high school graduate	Referent	Referent	Referent	Referent	Referent	Referent	Referent
High school graduate	2.2 (1.5–3.2)*	2.5 (1.7–3.7)*	1.4 (1.0–2.0)	1.8 (1.2–2.6)*	1.9 (1.1–3.2)*	2.5 (1.5–4.3)*	1.5 (1.0–2.2)
Some college or technical school	2.4 (1.7–3.5)*	3.0 (2.0–4.4)*	1.3 (0.9–1.9)	1.8 (1.3–2.6)*	1.7 (1.0–3.0)	2.1 (1.2–3.4)*	2.1 (1.5–3.0)*
College graduate	2.2 (1.5–3.2)*	3.0 (1.9–4.7)*	1.2 (0.9–1.8)	1.5 (1.1–2.2)*	1.7 (1.0–3.1)	2.5 (1.4–4.4)*	2.4 (1.7–3.6)*
Health risk factors (yes/no)							
Obesity	1.2 (1.0–1.5)	1.1 (0.9–1.4)	0.9 (0.8–1.1)	1.1 (0.9–1.3)	1.5 (1.02–2.1)*	1.2 (0.8–1.6)	1.0 (0.8–1.2)
Current smoker	1.0 (0.7–1.3)	1.0 (0.7–1.4)	1.1 (0.8–1.4)	1.3 (1.0–1.7)	1.3 (0.8–2.1)	0.8 (0.5–1.2)	1.2 (0.9–1.6)
COPD[a]	1.0 (0.7–1.4)	0.8 (0.5–1.2)	1.0 (0.7–1.2)	0.8 (0.6–1.0)	1.0 (0.7–1.3)	1.3 (0.9–2.0)	1.2 (0.9–1.6)
Depression	1.2 (1.0–1.6)	1.3 (1.0-1.6)	1.2 (0.9–1.5)	1.0 (0.8–1.3)	1.2 (0.8–1.9)	1.1 (0.8–1.6)	1.5 (1.2–1.9)*

(continued on next page)

graduate) (aOR = 2.2 [95% CI: 1.5–3.2], p < .05) than those who were not high school graduates. Adults who had semi-controlled asthma were 0.3 times less likely to recognize signs and symptoms of an asthma episode than those who had well controlled asthma (aOR = 0.7 [95% CI: 0.6–0.9], p < .05). Adjusted odds ratios were higher for those who had routine care visits than those who did not have routine care visits (aOR = 2.2 [95% CI: 1.7–2.8], p < .05) (Table 3).

For being taught how to respond to asthma episode, the adjusted odds ratios were lower for older adults (44-54 years old; aOR = 1.5 [95% CI: 1.1–2.0], p < .05) than for those 65 years or older. Adults with higher formal education (ie, some college) (aOR = 3.0 [95% CI: 2.0–4.4], p < .05) were more likely to have been taught how to respond to asthma episode than those who were not high school graduates. Adults who had health insurance (aOR = 1.6 [95% CI: 1.1–2.3], p < .05) and those who reported going to routine care visits (aOR = 2.4 [95% CI: 1.8–3.2], p < .05) were more likely to have been taught how to respond to an asthma episode (Table 3).

Table 3 (continued)
Association between Asthma Self-management Education Components and Demographic Characteristics of Participants with Active Asthma, Asthma Call-back Survey, 2014 (N = 9813)

Characteristics	Taught to recognize sign/symptoms of an episode Model 1 aOR (95% CI)	Taught to respond to an asthma episode Model 2 aOR (95% CI)	Taught how to use a peak flow meter Model 3 aOR (95% CI)	Given an asthma action plan Model 4 aOR (95% CI)	Taken asthma management course Model 5 aOR (95% CI)	Taught how to use an inhaler Model 6 aOR (95% CI)	Given advice on environmental control Model 7 aOR (95% CI)
Asthma control levels							
Poorly controlled	0.9 (0.7–1.3)	1.1 (0.7–1.6)	1.2 (0.8–1.5)	0.8 (0.6–1.2)	1.2 (0.7–2.1)	2.9 (1.7–5.0)*	1.4 (1.0–2.0)
Semi-controlled	0.7 (0.6–0.9)*	0.8 (0.6–1.1)	1.0 (0.8–1.2)	0.7 (0.6–1.0)	0.9 (0.6–1.5)	1.6 (1.1–2.5)*	1.5 (1.2–1.9)*
Well controlled	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Asthma episodes in past year (yes/no)	1.2 (0.9–1.6)	1.4 (1.0–2.0)	0.9 (0.7–1.2)	1.1 (0.9–1.5)	0.9 (0.6–1.3)	1.6 (1.1–2.5)*	0.8 (0.6–1.0)
Healthcare access and use (yes/no)							
Health insurance	1.1 (0.8–1.6)	1.6 (1.1–2.3)*	1.5 (1.01–2.1)*	0.9 (0.6–1.3)	1.2 (0.6–2.4)	1.6 (1.0–2.4)	1.4 (1.0–2.1)
Routine care visits	2.2 (1.7–2.8)*	2.4 (1.8–3.2)*	1.7 (1.3–2.1)*	1.8 (1.4–2.3)	1.8 (1.2–2.8)*	2.2 (1.6–3.2)*	1.5 (1.2–1.9)*
Emergency room visits	0.7 (0.5–1.0)	0.9 (0.5–1.4)	1.3 (0.9–1.8)	1.1 (0.8–1.6)	0.9 (0.6–1.5)	1.1 (0.5–2.4)	1.2 (0.8–1.6)
Urgent care visits	1.1 (0.8–1.6)	1.1 (0.8–1.6)	0.9 (0.7–1.2)	1.5 (1.1–1.9)*	1.0 (0.7–1.5)	1.2 (0.8–2.0)	1.0 (0.7–1.3)
Hospitalization	1.9 (1.0–3.7)	1.2 (0.5–2.5)	2.3 (1.4–3.9)*	1.6 (0.9–2.6)	1.9 (0.9–3.8)	0.6 (0.2–1.6)	1.0 (0.6–1.8)
Cost as barrier (yes/no)							
Medication cost	1.1 (0.8–1.6)	1.2 (0.8–1.7)	1.0 (0.7–1.4)	1.2 (0.8–1.9)	1.4 (0.5–3.8)	1.3 (0.8–2.3)	0.8 (0.6–1.2)
Primary care physician visit costs	1.1 (0.7–1.8)	1.0 (0.6–1.6)	1.5 (0.9–2.2)	0.9 (0.5–1.4)	1.0 (0.5–2.2)	1.0 (0.5–2.1)	1.5 (0.9–2.4)
Specialist visit cost	1.0 (0.6–1.7)	0.9 (0.6–1.6)	0.8 (0.5–1.3)	1.1 (0.6–1.9)	1.3 (0.6–2.9)	0.4 (0.2–0.9)*	1.3 (0.8–2.3)

*p < .05

Note.
'no' is the reference category for all 'yes/no' variables
OR = adjusted odds ratios; CI = confidence intervals; COPD = chronic obstructive pulmonary disease
a: Reported having COPD, emphysema, or chronic bronchitis.

Peak flow meter (PFM) instruction was more likely for Blacks (aOR = 1.8 [95% CI: 1.3–2.6], p < .05) than Whites. Persons who identify as 'other race' were more likely to have received PFM instruction than Whites (aOR = 1.7 [95% CI: 1.1–2.5], p < .05). Adults who reported having health insurance (aOR = 1.5 [95% CI: 1.01–2.1], p < .05), a routine care visit (aOR = 1.7 [95% CI: 1.3–2.1], p < .05), or hospitalization (aOR = 2.3 [95% CI: 1.4–3.9], p < .05) were more likely to receive PFM instruction (Table 3). An asthma action plan was more likely to be given to adults aged 35-44 years old (aOR = 1.5 [95% CI: 1.1–2.0], p < .05) than those 65 years or older. Adults with higher levels of education (ie, high school graduates) (aOR = 1.8 [95% CI: 1.2–2.6], p < .05) reported receiving an asthma action plan than those who were not high school graduates. Adults who reported an urgent care visit (aOR = 1.5 [95% CI: 1.1–1.9], p < .05) were more likely to be given an asthma action plan versus those who did not receive an urgent care visit (Tabe1 3).

An asthma management course was more likely for Blacks (aOR = 2.0 [95% CI: 1.3–3.3], p < .05) than Whites. Adults who identified their highest level of education as a high school graduate (aOR = 1.9 [95% CI: 1.1–3.2], p < .05) were more likely to have taken an asthma management course than those who were not a high school graduate, adults who identified as being obese (aOR = 1.5 [95% CI: 1.02–2.1], p < .05) and those who reported a routine care visit (aOR = 1.8 [95% CI: 1.2–2.8], p < .05) (Tabe1 3).

Instruction in inhaler use was associated with sex, age, education, asthma control levels, asthma episodes per year, routine care visit, and specialist

Table 4
Association between Asthma Self-management Education Score and Demographic Characteristics of Participants with Active Asthma, Asthma Call-back Survey, 2014 (N = 9813)

Characteristics	aB (SE)	aβ
Sex		
Male	Referent	Referent
Female	0.21 (0.08)*	2.70
Age group (years)		
18-34	0.67 (0.11)*	5.81
35-44	0.60 (0.14)*	4.41
45-54	0.46 (0.10)*	4.77
55-64	0.43 (0.09)*	4.94
65+	Referent	Referent
Race and ethnicity		
White, non-Hispanic	Referent	Referent
Black, non-Hispanic	0.25 (0.12)*	1.98
Hispanic	0.09 (0.14)	0.62
Other	0.09 (0.13)	0.73
Education		
Not high school graduate	Referent	Referent
High school graduate	0.78 (0.18)*	4.34
Some college or technical school	0.87 (0.18)*	4.92
College graduate	0.85 (0.18)*	4.72
Health risk factors (yes/no)		
Obesity	0.11 (0.08)	1.35
Current smoker	0.09 (0.11)	0.87
COPD[a]	-0.01 (0.11)	-0.10
Depression	0.24 (0.09)*	2.66
	(continued on next column)	

Table 4 (continued)
Association between Asthma Self-management Education Score and Demographic Characteristics of Participants with Active Asthma, Asthma Call-back Survey, 2014 (N = 9813)

Characteristics	aB (SE)	aβ
Asthma control levels		
Poorly controlled	0.16 (0.12)	1.30
Semi-controlled	-0.03 (0.10)	-0.35
Well controlled	Referent	Referent
Asthma episodes in past year (yes/no)	0.07 (0.10)	0.75
Healthcare access and use (yes/no)		
Health insurance	0.33 (0.15)*	2.21
Routine care visits	0.75 (0.08)*	9.21
Emergency room visits	0.03 (0.13)	0.25
Urgent care visits	0.09 (0.10)	0.92
Hospitalization	0.50 (0.23)*	2.15
Cost as barrier (yes/no)		
Medication cost	0.09 (0.17)	0.50
Primary care physician visit costs	0.18 (0.18)	1.02
Specialist visit cost	-0.05 (0.21)	-0.24

*$p < .05$

Note.
'no' is the reference category for all 'yes/no' variables
aB = adjusted unstandardized regression coefficient; SE = standard error;
aβ = adjusted standardized regression coefficient; COPD = chronic obstructive pulmonary disease
a: Reported having COPD, emphysema, or chronic bronchitis

visit cost barrier. Women were more likely to have been taught to use an inhaler than men (aOR = 1.5 [95% CI: 1.1–2.0], $p < .05$). Adults younger than 65 years were more likely to receive inhaler use instruction. Adults aged 18-34 years old were more likely to receive instruction in inhaler use than adults aged 65 years or older (aOR = 3.9 [95% CI: 2.5–6.3], $p < .05$). Adults with a higher formal education (ie, college graduate) were more likely to receive inhaler use instruction (aOR = 2.5 [95% CI: 1.4–4.4], $p < .05$) than those who were not high school graduates. Adults who reported having an asthma episode in the past year (aOR = 1.6 [95% CI: 1.1–2.5], $p < .05$), or a routine care visit (aOR = 2.2 [95% CI: 1.6–3.2], $p < .05$) were more likely to receive inhaler use instruction. Adults who had a specialist cost barrier were less likely to have received inhaler use instruction (aOR = 0.4 [95% CI: 0.2–0.9], $p < .05$) (Table 3).

The adjusted odds ratio for advice on environmental control for asthma were higher for women than for men (aOR = 1.3 [95% CI: 1.04–1.6], $p < .05$); they were higher for younger adults aged 18-34 years old than for adults aged 65 years or older (aOR = 2.5 [95% CI: 1.8–3.4], $p < .05$). Persons who had some college or technical college and college graduates were more likely to have received advice on environmental control for asthma (aOR = 2.1 [95% CI: 1.5–3.0], $p < .05$; aOR = 2.4 [95% CI: 1.7–3.6], $p < .05$, respectively). Adults with

physician diagnosed depression were more likely to receive advice on environmental control for asthma than those who were not diagnosed with depression (aOR = 1.5 [95% CI: 1.2–1.9], p < .05). Adults who had semi-controlled asthma were more likely to receive advice on environmental control for asthma versus those who had well-controlled asthma (aOR = 1.5 [95% CI: 1.2–1.9], p < .05). Furthermore, adults who stated having a routine care visit (aOR = 1.5 [95% CI: 1.2–1.9], p < .05) were more likely to receive advice on environmental control (Table 3).

Demographic characteristics sex, age, race and ethnicity and education were associated with self-management asthma education score. Women were more likely to have a higher asthma self-management score than men (aB = 0.21, [SE = 0.08], p < .05). Younger adults were more likely to have a higher asthma self-management score than older adults (18-34 vs 65+: aB = 0.67, [SE = 0.11], p < .05; 35-44 vs 65+: aB = 0.60, [SE = 0.14], p < .05; 45-54 vs 65+: aB = 0.46, [SE = 0.10], p < .05; 55-64 vs 65+: aB = 0.43, [SE = 0.09], p < .05, respectively). Blacks were more likely to have a higher asthma self-management score than Whites (aB = 0.25, [SE = 0.12], p < .05).

The adjusted unstandardized coefficients were higher for adults who were college graduate than adults who were not high school graduates (aB = 0.85, [SE = 0.18], p < .05). This indicates that more highly educated persons were more likely to have higher asthma education scores. Adults with physician diagnosed depression were more likely to have higher asthma education scores than those who did not have depression (aB = 0.24, [SE = 0.09], p < .05). Adults who reported having health insurance (aB = 0.33, [SE = 0.15], p < .05), a routine care visit (aB = 0.75, [SE = 0.08], p < .05), or hospitalization (aB = 0.50, [SE = 0.23], p < .05) were more likely to have a higher asthma education score than those who did not have those healthcare access and use characteristics (Table 4).

DISCUSSION

Most adults with active asthma were more likely to have received one or more asthma education components. Compared with men, women were likely to have active asthma knowledge. The most commonly reported asthma education components were being taught to use an inhaler, to respond to an asthma episode, and to recognize signs of an onset of an asthma episode and the symptoms of asthma. The most holistic, yet least commonly reported event was having a formal education around the topic of asthma. Demographics, healthcare access, and healthcare use were associated with asthma education status among adults with active asthma. This finding was consistent and comparable to findings in a report by the US Centers for Disease Control and Prevention (CDC)[16,21] that noted that education is an important component of improving chronic active asthma. Additionally, our findings demonstrate that adults (88.5%) with active asthma possessed health insurance, but 12.0% of participants expressed cost concerns about buying medication to treat their asthma. In other words, access to healthcare was a barrier for these adults. It is interesting to note that 23% of the participants indicated costs associated with medication treatment, primary care, and specialist care were of concern. Moreover, as adults had access to healthcare, they had knowledge of care around asthma medication, were able to use an inhaler correctly and monitor their symptoms, which led to improved self-management.[3,6] The National Institutes of Health-National Asthma Education and Prevention Program (NIH-NAEPP) expert panel recommends that asthma education messages be communicated and reinforced at every possible occasion during visits with medical professionals, including settings such as schools and community centers.[10]

Research concerning asthma management, asthma education, and asthma management effectiveness demonstrates that aspects of asthma care is based on management, assessment, education, treatment, and maintenance of surrounding environment.[7-10] In following these aspects of asthma, one's hospitalization and routine care by a medical profession were related to being aware of asthma and knowledge of asthma education, which led to greater self-reported asthma knowledge, awareness, and education among adults, which reduced their visits for unscheduled care.[11,12] Moreover, asthma education needs to be taught, reinforced, and reiterated and throughout healthcare.

Almost half of the adults in this study reported their asthma to be less than appropriately con-

trolled. A concern that arises however, is the decline in lung capacity, function, and other health conditions as adults age, events that could explain why we obtained the results we did.[22] We found current smoking status and having limited formal education to be associated with poor health among asthmatics. Secondhand smoking was not taken into account as this dataset did not have a clear variable to determine this status. We found depression was associated with receiving advice on environmental control. One possible explanation for this finding is that depressed adults may start thinking of a suicide plan regarding dying peacefully and some research indicates that asthma is a risk factor for suicide behavior among adults.[23]

As our results show, the specialist cost barrier was associated with inhaler instruction. Research on inhaler instruction indicates that an asthma specialist is the person who trains patients with difficult to severe asthma to use their inhaler as directed.[24-26] Despite these poor health outcomes, adults who were older reported receiving less asthma education than their younger adult counterparts. This indicates that asthma education is vital to asthma control, quality of life, and disease management. However, the people who need the most care due to other contributing health conditions are receiving this education far less.[10] Furthermore, improving asthma management through patient and physician training should add to better health-related asthma outcomes for these people.

The current study has some limitations. First, these data are based on self-report statements from a phone survey. The participants in this study may have been answering questions based on how they though the researcher wanted them to reply which produces social desirability issues. Secondly, our findings are not generalizable to residents in states that did not participate in the BRFSS-ACBS. Lastly, as this study was focused solely on adults, our findings cannot be attributed to children as no questions regarding children with active asthma were examined.

Conclusion

Our results provide some predictors of asthma self-management education for adults with active asthma. Being female, a person of color, having an asthma episode, having healthcare access, and routine care/visits were associated with receiving asthma education and suggest where these components were administered. These findings demonstrate that adults who experience asthma would benefit from any type of health education component to gain the skills necessary to manage their own care and asthma health outcomes. The current study did not investigate questions on the quality, quantity, or mode of asthma education, along with whether recipients followed instructions as directed by their healthcare provider. As a result, future studies need to assess the modes of asthma education that are best for treatment/control. Additionally, the NIH-NAEPP should aid healthcare providers in implementing asthma education courses to all based on their guidelines. The NIH-NAEPP should promote culturally competent support care, and services to communities of color to improve their access to asthma knowledge and health education. One recommendation would be to provide free services to persons with asthma through community centers and health departments that provide culturally competent health education programs for minorities who otherwise would not have healthcare access unless they sought ER services. Another recommendation would be to provide health advocacy to high school students as we found that more highly educated people were more likely to receive asthma self-management education. This will provide an avenue enabling adults, regardless of education level, to receive proper asthma health education training.

Human Subjects Statement

Texas Woman's University Institutional Review Board reviewed this study and considered it to have an exempt status.

Conflict of Interest Statement

The authors have no conflict of interest to declare.

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