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Assessing health outcomes, quality of life, and healthcare use among school-age children with asthma

Matthew J Lozier[1], **Hatice S Zahran**[1], **Cathy M Bailey**[1]

[1]Division of Environmental Hazards and Health Effects, Centers for Disease Control and Prevention, San Juan, Puerto Rico.

Abstract

Objective—Asthma affects 6 million children in the United States. Most people can control their asthma symptoms with effective care, management, and appropriate medical treatment. Information on the relationship between asthma control and quality of life indicators and health care use among school-age children is limited.

Methods—Using the 2006–2010 combined Behavior Risk Factor Surveillance System Asthma Call-back Survey child data, we examined asthma control and asthma attack status among school-age (aged 5–17 years) children with asthma from 35 states and the District of Columbia. Multivariable logistic regression models were used to assess if having uncontrolled asthma and having ≥1 asthma attacks affect quality of life (activity limitation and missed school days) and healthcare use (emergency department [ED] visits and hospitalizations).

Results—About one-third (36.5%) of the 8,484 respondents with current asthma had uncontrolled asthma and 56.8% reported ≥1 asthma attack in the past year. Having uncontrolled asthma and having ≥1 asthma attack were significantly associated with activity limitation (aPR=1.43 and 1.74, respectively), missed school (1.45 and 1.68), ED visits (2.05 and 4.78), and hospitalizations (2.38 and 3.64). Long-term control (LTC) medication use was higher among respondents with uncontrolled asthma (61.3%) than respondents with well-controlled asthma (33.5%).

Conclusions—Having uncontrolled asthma is associated with reduced quality of life and increased health care use. However, only 61.3% of respondents with uncontrolled asthma use LTC medications. Increasing use of LTC medications among children with uncontrolled asthma could help improve quality of life and reduce health care use.

Keywords

uncontrolled asthma; long-term control medication; asthma attacks; ED visit; hospitalization; activity limitation; missed school days

Declaration of interest

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Introduction

Asthma is a chronic inflammatory disease of the airways that affects nearly one in 12 U.S. children (1). Uncontrolled asthma is associated with significantly reduced quality of life and increased health care use (2–4). For example, in children aged 0–17 years, asthma significantly limits activity and results in an estimated 10 million missed school days annually (5). In addition, surveys report that 3.5 million children had at least one asthma attack in 2013 (1). Childhood asthma also places a significant burden on health care facilities, with more than 611,000 asthma-related emergency department (ED) visits and 136,000 asthma-related hospitalizations in 2010 (1).

Although asthma cannot be cured, with effective care and management, most people with asthma can control their disease, leading to a reduction in asthma attacks and urgent health care use and improving quality of life. A recent publication assessed the level of asthma control, which was defined by using the National Asthma Education and Prevention Program Expert Panel Report 3 Guidelines (6). The objectives of this study are to identify factors associated with uncontrolled asthma and asthma attack among school-aged children with asthma and to evaluate if having uncontrolled asthma and asthma attack are associated with quality of life and health care use indicators.

Methods

Survey data description

We combined 5 years of data to produce stable estimates. We analyzed the 2006 through 2010 child Asthma Call-back Survey (ACBS) data from CDC's Behavioral Risk Factor Surveillance System (BRFSS). Our study includes children aged 5–17 from 35 states and the District of Columbia (https://www.cdc.gov/asthma/ACBS/ACBStechnical.htm).

The Air Pollution and Respiratory Health Branch (APRHB) of the National Center for Environmental Health (NCEH) at CDC develops and funds the BRFSS ACBS, which has been implemented as a follow-up survey to the BRFSS since 2006. Interviewers conduct the BRFSS ACBS approximately 2 weeks after the BRFSS telephone survey. Although the BRFSS is a state-based, random-digit-dialed telephone survey of non-institutionalized U.S. adults, the survey contains a Random Child Selection module and a Child Asthma Prevalence module to identify households with a child who has asthma. BRFSS respondents or proxy respondents who report children who have ever been diagnosed with asthma are eligible for the ACBS. Only one adult or one child per household can participate in the ACBS. An adult family member serves as a proxy respondent for the selected child. The ACBS collects in-depth information about asthma symptoms and episodes/attacks, self-management education, healthcare access and use, medication use, comorbidities, and environmental allergens and irritants.

The ACBS response rate for children varies by state and year. During 2006–2010, the median ACBS response rates for children (via adult proxies) ranged from 47.6% to 53.7%. The data include sample weights to adjust for the unequal probability of selection, the disproportionate selection of population subgroups relative to the state's population

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distribution, and disproportionate non-response. More information on participating states, weight calculation, and response rates can be found in the ABCS Summary Data Quality Report for each year at http://www.cdc.gov/brfss/acbs.

Variables

We characterized asthma control status, asthma attacks, health care use, and quality of life among children with current asthma. We considered children to have current asthma if the proxy respondents answered "yes" to both questions: "Have you ever been told by a doctor or other health professional that [child's name] had asthma?" and "Does [he/she] still have asthma?"

We used the methods previously described by Zahran et al. (6) to create a guideline-based control variable with two mutually exclusive categories: well-controlled asthma and uncontrolled asthma. Respondents were assigned to a category based on the most impaired level across the three impairment measures: daytime symptom frequency, nighttime symptom frequency, and use of short-acting β2-agonists (SABA) for symptom control. The demographic characteristic variables included in the analyses were age, sex, race/ethnicity, and annual household income. Health-related variables were health care access and use (health insurance, routine care visit, ED visit, urgent care visit, and hospitalization), and long-term control (LTC) medications (inhaled corticosteroids, systemic corticosteroids, long-acting beta agonists, leukotriene receptor antagonists, and immunomodulators). Cost as a barrier to medical care (being unable to see a primary care physician or specialist for asthma care or unable to buy medication for asthma in the past 12 months) was the final variable. The variable "ED visit" includes visits to ED or urgent care centers whereas the variable "urgent care visit" includes visits to medical providers for urgent treatment of asthma symptoms.

We characterized quality of life by assessing activity limitation caused by asthma and missed school days caused by asthma. First, we collapsed responses to the question, "During the past 12 months, would you say [child's name] limited [his/her] usual activities due to asthma not at all, a little, a moderate amount, or a lot?" into two categories: "Not at all" and "A little/moderate/lot." Additionally, we dichotomized responses to the question, "During the past 12 months, about how many days of school did [he/she] miss because of [his/her] asthma?" into "None" and "One or more."

Statistical analysis

We used SAS-callable SUDAAN (version 11.0.0, TRI International, NC) to account for the complex sampling design of the BRFSS ACBS. Data from the participating states for each year were proportionately reweighted to account for the differences in sample size by year and the number of years each state participated. We used sample weights to produce estimates that were generalizable to a participating state's population and the chi-squared test to test for group difference. We presented weighted percent estimates, adjusted prevalence ratios (aPR) (predicted marginal risk ratio), and 95% confidence intervals (CI). Adjusted PR is considered statistically significant if 95% CI does not overlap the null

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value of one. We adjusted aPRs for age, sex, race/ethnicity, household income, health care coverage, cost as barrier to medical care, and LTC medications.

Results

Characteristics

The combined 2006 through 2010 BRFSS ACBS sample contained 8,484 children aged 5–17 years with current asthma (Table 1). More than half of the children were male (55.8%) and 53.3% were aged 5–11 years. The majority of respondents were non-Hispanic white (58.9%); nearly equal numbers were Black or Hispanic (15.4% and 15.9%, respectively); and the remainder were “other race” (9.9%). About one-third (37.1%) of respondents reported household income ≥$75,000 and 26.0% reported household income <$25,000. Nearly all of the children had full year health insurance coverage for the past 12 months (90.6%), and 73.4% had a routine care visit for asthma in the past 12 months. Overall, health care use because of asthma was reported by 35.4% (urgent care visit), 16.2% (emergency department (ED) visit) and 3.0% (hospitalization) of respondents. Among children aged 5–17 years with current asthma, 43.6% used LTC medications, and 10.9% reported one or more costs as barriers to asthma health care or medication.

Uncontrolled asthma

Among all children with current asthma aged 5–17, 63.5% had well-controlled asthma and 36.5% had uncontrolled asthma (Table 1). Several factors were associated with uncontrolled asthma, even while adjusting for all other factors in the regression model (Table 1). Children from households with income <$15,000 had a significantly higher prevalence of uncontrolled asthma (48.8%) than children from households with income ≥$75,000 (33.7%) (aPR=1.39; 95% confidence interval [CI]=1.10, 1.75). Using LTC medications was significantly associated with having uncontrolled asthma (aPR=2.08; 95% CI=1.81, 2.38). Among children with uncontrolled asthma, 61.3% were taking LTC medications (data are not shown). In addition, children with one or more cost barriers to asthma health care or medication had a significantly higher prevalence of uncontrolled asthma than children with no cost barriers (aPR=1.28; 95% CI=1.03, 1.60). Sex, age, race/ethnicity, and insurance coverage status did not show statistically significant associations with prevalence of uncontrolled asthma.

Asthma attack in past year

Among all respondents, 56.8% (95% CI=54.3, 59.2) of children aged 5–17 years with current asthma had at least one asthma attack in the past year, while 43.2% (95% CI=40.8, 45.7) had no asthma attack in the past year (Table 2). The only factor showing a significant association with having at least one asthma attack in the last 12 months was using LTC medications. Using LTC medications (67.8%) was significantly associated with having ≥1 asthma attack in the past year (aPR=1.39; 95% CI=1.28, 1.51). Finally, children who had one or more cost barriers to asthma health care or medication were more likely to have ≥1 asthma attack in the past year (65.3%) than children with no cost barriers (34.7%). However, this association was no longer statistically significant after adjusting for potential

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confounding factors (aPR=1.14; 95% CI=1.00, 1.31). Sex, age, race/ethnicity, insurance status, and household income showed no associations with asthma attacks in the past year.

Quality of life and health care use

Children aged 5–17 years with current asthma experienced reductions in quality of life as measured by activity limitation and missing one or more school days due to asthma. Overall, 61.6% (95% CI=59.2, 63.9) of children had any activity limitation during the past 12 months and 49.8% (95% CI=47.2, 52.3) of children missed one or more school days during the past 12 months (Table 3). These measures demonstrated a significant association with both asthma control status and ≥1 asthma attack in the past year. Among children with uncontrolled asthma, 78.5% limited their activity due to asthma, compared with 51.8% of children with well-controlled asthma (aPR=1.43; 95% CI=1.33, 1.54). Among children who had ≥1 asthma attacks in the past year, 76.4% had activity limitation due to asthma, compared with 42.0% of children who did not have an asthma attack in the past year (aPR=1.74; 95% CI=1.59, 1.91) (Table 3). Asthma control status and having at least one asthma attack in the past year had similar associations with missing one or more school days in the past year due to asthma (aPR=1.45; 95% CI=1.32, 1.59 and aPR=1.68; 95% CI=1.50, 1.89; respectively) (Table 3).

Among all children aged 5–17 years with current asthma, 16.2% (95% CI=14.4, 18.2) visited an ED or urgent care center due to asthma in the past 12 months, and 3.0% (95% CI=2.2, 4.1) were hospitalized due to asthma in the past 12 months (Table 3). Both of these health care use measures were significantly associated with uncontrolled asthma and having at least one asthma attack in the past year. Among children with uncontrolled asthma, 27.1% visited the ED or urgent care center due to asthma, compared with 10.0% of children with well-controlled asthma (aPR=2.05; 95% CI=1.62, 2.59). Among children who had at least one asthma attack in the past year, 25.4% visited the ED or urgent care center due to asthma, compared with 4.4% of children who did not have an asthma attack in the past year (aPR=4.78; 95% CI=3.27, 6.99). Uncontrolled asthma and at least one asthma attack in the past year had similar associations with being hospitalized in the past 12 months due to asthma (aPR=2.38; 95% CI= 1.22, 4.64 and aPR=3.64; 95% CI=1.48, 8.97, respectively).

Discussion

In this study, we investigated health outcomes, quality of life, and healthcare use among school-age children with asthma and explored the association between them. Consistent with previous findings (6), our study found that not all children with uncontrolled asthma were taking LTC medications as current national asthma diagnosis and management guidelines recommend (7). This may partially explain higher prevalence of uncontrolled asthma (36%) and asthma attacks (57%) among the study population. In addition, some of those who were taking LTC medications may still be having asthma exacerbations and uncontrolled asthma given that taking LTC medications does not always correlates with better health outcomes. If someone receives suboptimal treatment for various reasons (inappropriate dose or type of asthma control medications, non-adherence to treatment regimens, not taking it regularly as prescribed because cannot afford medications, and resistance to treatment) (7–9), it is

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more likely that they will continue to have asthma exacerbations and uncontrolled asthma despite taking LTC medications. Further identifying modifiable predictors of uncontrolled asthma and medication use is an important step in developing targeted strategies to promote better asthma care and management, thereby improve health outcomes among children with asthma.

Consistent with previous studies (6, 9), having uncontrolled asthma or asthma attack was strongly associated with long-term asthma control (LTC) medication use. This is an expected finding because persons with symptoms are more likely to recall taking their medications and healthcare providers are more likely to prescribe LTC medications for those with uncontrolled symptoms given that the current guidelines for the management of asthma recommend treating all people with uncontrolled asthma with LTC medications, especially inhaled corticosteroids (7). Also, Engelkes et al (8) reported that patients with more severe asthma exacerbations were more likely to adhere to treatment, therefore, were more likely use asthma medications.

Based on the current guidelines (7), we expected to find that all children with uncontrolled asthma were on long-term control medications. However, our findings show that only about 61% of children with uncontrolled asthma were on LTC medications. Strategies to improve access to appropriate medical therapy as defined in the 2007 National Asthma Education and Prevention Program guidelines and to increase adherence to therapy among persons with asthma may further improve asthma-related health outcomes.

Studies provide plenty of evidence showing the relationship between poverty and poor health. That is, people with low levels of education and income generally experience poor health, exhibit more risk-taking behaviors, and have decreased access to and quality of healthcare (6, 10, 11). As expected, the current study shows that an annual household income less than $15,000 and healthcare cost barriers to medical care were strong predictors of uncontrolled asthma. The findings suggest the need for coordinated efforts at the local, state, and national levels to develop programs to address unmet health care needs among children in families with low income to better control and manage their asthma.

What differentiates this study from several others is that we examined the association between adverse health outcomes and quality of life and healthcare use. We found that about three-fourths of children (aged 5–17 years) with uncontrolled asthma or with ≥1 asthma attack had activity limitations because of asthma, and about two-thirds of them missed school days because of asthma in the past year. In addition, among children with uncontrolled asthma or with ≥1 asthma attack, about 25% visited EDs or urgent care centers, and about 5% were hospitalized in the past year because of asthma. Although different measures have been used, these strong associations have been previously reported (2–4, 6). Identifying modifiable predictors of uncontrolled asthma and episodes/attacks (LTC medication use, income, and health care access) is an important step in developing targeted strategies to improve the health and well-being of people with asthma. CDC’s National Asthma Control Program funds states and non-government organizations to develop strategies aimed at improving health and quality of life among school-age children with asthma.

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The strength of this study is the ability to assess adverse health outcomes, quality of life, and healthcare use among the large sample of children aged 5–17 years with current asthma from the states participating in the ACBS. The ACBS is the only survey in multiple states with indicators that allow a guideline-based classification of asthma control and evaluation of population-based, asthma-related health outcomes and quality of life (12).

The findings in this report are subject to limitations. The BRFSS Child ACBS data are based on adult proxy responses for children; therefore, the findings might be biased because of inaccurate recall or the social desirability of providing positive responses. However, the reporting bias might be minimized because the most knowledgeable adult family member is selected to be a proxy respondent for the selected child (12). Another limitation is that the findings are based on cross-sectional survey data, and we cannot generally determine temporal sequence or causality. However, we can determine the magnitude and the direction of the association between outcome variables and explanatory variables. Finally, the study population is children aged 5–17 years; therefore, the findings cannot be generalized either to all children (aged 0–17 years) or to children aged 5–17 years with current asthma in states that did not participate in the ACBS.

Conclusions

Despite national guidelines aimed at improving asthma care and management, 36% of children aged 5–17 years with current asthma had uncontrolled asthma, 57% had at least one asthma attack in the past year, and not all those with uncontrolled asthma were on long-term control (LTC) medications as recommended by the asthma treatment guidelines. Adverse health outcomes such as uncontrolled asthma or ≥1 asthma attack/episode per year are strongly associated with reduced quality of life (activity limitation and missed school days) and increased health care use (ED visits and hospitalization) because of asthma. Use of LTC medications, low income, and cost as a barrier to medical care were strong predictors of uncontrolled asthma. These findings suggest the need for coordinated efforts at the local, state, and national levels to develop strategies to address unmet health care needs among children with low income and to increase the use of long-term control medications among children with uncontrolled asthma. Both strategies could help improve quality of life and reduce expensive healthcare use.

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Table 1.

Weighted percentages of characteristics by asthma control status and adjusted prevalence ratios (aPR) of children aged 5–17 years with current asthma: Behavioral Risk Factor Surveillance System Asthma Call-back Survey, 2006–2010

Characteristics	Survey respondents[1]		Well-controlled asthma		Uncontrolled asthma[2]		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	aPR[3] (95% CI)
Overall	8,484	100	5,508	63.5 (61.1, 65.9)	2,976	36.5 (34.1, 38.9)	
Sex							
Male	4,788	55.8 (53.3, 58.3)	3,147	64.5 (61.2, 67.6)	1,641	35.5 (32.4, 38.8)	*ref*
Female	3,663	44.2 (41.7, 46.7)	2,344	62.4 (58.5, 66.2)	1,319	37.6 (33.8, 41.5)	1.09 (0.97, 1.24)
Age, year range							
5–11	3,746	53.3 (50.8, 55.8)	2,307	62.0 (58.6, 65.3)	1,439	38.0 (34.7, 41.4)	0.97 (0.86, 1.10)
12–17	4,738	46.7 (44.2, 49.2)	3,201	65.2 (61.6, 68.7)	1,537	34.8 (31.3, 38.4)	*ref*
Race/Ethnicity							
White	5,771	58.9 (56.3, 61.5)	3,835	64.6 (61.8, 67.2)	1,936	35.4 (32.8, 38.2)	*ref*
Black	825	15.4 (13.5, 17.5)	458	55.1 (47.5, 62.5)	367	44.9 (37.5, 52.5)	1.17 (0.98, 1.39)
Hispanic	804	15.9 (13.8, 18.2)	507	62.7 (54.8, 70.1)	297	37.3 (29.9, 45.2)	0.98 (0.80, 1.20)
Other race	764	9.9 (8.3, 11.8)	513	69.8 (61.5, 77.0)	251	30.2 (23.0, 38.5)	0.84 (0.66, 1.08)
Household income[4]							
<$15000	685	11.9 (9.8, 14.4)	364	51.2 (40.5, 61.8)	321	48.8 (38.2, 59.5)	**1.39 (1.10, 1.75)**
$15000–$24999	1,054	14.1 (12.4, 16.0)	623	58.7 (51.4, 65.7)	431	41.3 (34.3, 48.6)	1.18 (0.97, 1.44)
$25000–$49999	1,858	20.8 (19.0, 22.8)	1,187	63.0 (58.2, 67.5)	671	37.0 (32.5, 41.8)	1.02 (0.86, 1.21)
$50000–$74999	1,467	16.1 (14.5, 17.8)	983	70.1 (65.3, 74.6)	484	29.9 (25.4, 34.7)	0.89 (0.74, 1.06)
≥$75000	2,967	37.1 (34.8, 39.6)	2,067	66.3 (62.6, 69.8)	900	33.7 (30.2, 37.4)	*ref*
Health care access and use							
Health insurance							
No insurance	297	3.8 (3.0, 4.9)	187	64.0 (52.1, 74.4)	110	36.0 (25.6, 47.9)	1.07 (0.80, 1.43)
Partial year coverage	417	5.6 (4.1, 7.4)	230	51.1 (36.1, 66.0)	187	48.9 (34.0, 63.9)	1.28 (0.93, 1.75)
Full year coverage	7,743	90.6 (88.6, 92.3)	5,072	64.2 (61.7, 66.6)	2,671	35.8 (33.4, 38.3)	*ref*
Routine care visit	5,894	73.4 (71.3, 75.4)	3,412	57.2 (54.1, 60.2)	2,482	42.8 (39.8, 45.9)	*NA*

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Characteristics	Survey respondents[1]		Well-controlled asthma		Uncontrolled asthma[2]		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	aPR[3] (95% CI)
ED visit	1,125	16.2 (14.4, 18.2)	440	39.0 (33.0, 45.4)	685	61.0 (54.6, 67.0)	*NA*
Urgent care visit	2,501	35.4 (32.9, 37.9)	1,209	48.1 (43.4, 52.7)	1,292	51.9 (47.3, 56.6)	*NA*
Hospitalization	193	3.0 (2.2, 4.1)	67	30.0 (18.2, 45.2)	126	70.0 (54.8, 81.8)	*NA*
Long-term control medications[5]	3,677	43.6 (41.2, 46.1)	1,867	48.8 (45.2, 52.4)	1,810	51.2 (47.6, 54.8)	**2.08 (1.81, 2.38)**
Cost as a barrier							
Medication cost	574	8.3 (6.8, 10.0)	268	47.5 (37.7, 57.5)	306	52.5 (42.5, 62.3)	*NA*
Primary care physician visit cost	328	4.2 (3.5, 5.2)	144	46.7 (36.4, 57.2)	184	53.3 (42.8, 63.6)	*NA*
Specialist visit cost	200	3.0 (2.2, 4.0)	80	48.5 (33.7, 63.6)	120	51.5 (36.4, 66.3)	*NA*
Any cost barrier[5]	784	10.9 (9.3, 12.7)	368	49.7 (41.5, 58.0)	416	50.3 (42.0, 58.5)	**1.28 (1.03, 1.60)**

Abbreviations: N, Sample size; CI, 95% confidence interval; ED, emergency department

[1] Numbers within selected characteristics may not sum to total due to missing responses

[2] Uncontrolled asthma based on 3 variables: nighttime symptoms, daytime symptoms, and SABA use.

[3] The adjusted prevalence ratio compares prevalence of people with uncontrolled asthma among category subgroups. Adjusted for age, sex, race/ethnicity, household income, health care coverage, cost as barrier to medical care, and long-term control meds.

[4] Income was missing for 5.6% (survey respondents) and 5.2% (uncontrolled asthma) and 4.7% (at least one asthma attack in past year) participants.

[5] The reference values for these characteristics are “do not use long-term control medications” and “no cost barriers,” respectively.

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Table 2.

Weighted percentages of characteristics by asthma attack status in past year and adjusted prevalence ratios (aPR) of children aged 5–17 years with current asthma: Behavioral Risk Factor Surveillance System Asthma Call-back Survey, 2006–2010

Characteristics	Survey respondents[1]		No asthma attack in past year		≥1 asthma attack in past year		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	aPR[2] (95% CI)
Overall	8,484	100	3,828	43.2 (40.8, 45.7)	4,584	56.8 (54.3, 59.2)	
Sex							
Male	4,788	55.8 (53.3, 58.3)	2,196	44.8 (41.5, 48.1)	2,556	55.2 (51.9, 58.5)	*ref*
Female	3,663	44.2 (41.7, 46.7)	1,622	41.4 (37.8, 45.0)	2,005	58.6 (55.0, 62.2)	1.09 (1.00, 1.18)
Age, year range							
5–11	3,746	53.3 (50.8, 55.8)	1,562	40.3 (36.9, 43.7)	2,157	59.7 (56.3, 63.1)	1.08 (1.00, 1.17)
12–17	4,738	46.7 (44.2, 49.2)	2,266	46.6 (43.2, 50.1)	2,427	53.4 (49.9, 56.8)	*ref*
Race/Ethnicity							
White	5,771	58.9 (56.3, 61.5)	2,566	42.6 (39.9, 45.4)	3,151	57.4 (54.6, 60.1)	*ref*
Black	825	15.4 (13.5, 17.5)	359	39.4 (33.0, 46.3)	463	60.6 (53.7, 67.0)	1.03 (0.92, 1.16)
Hispanic	804	15.9 (13.8, 18.2)	384	47.5 (39.4, 55.7)	413	52.5 (44.3, 60.6)	0.90 (0.77, 1.05)
Other race	764	9.9 (8.3, 11.8)	375	46.6 (37.4, 56.1)	381	53.4 (43.9, 62.6)	0.92 (0.78, 1.10)
Household income[3]							
<$15000	685	11.9 (9.8, 14.4)	292	42.6 (32.6, 53.1)	387	57.4 (46.9, 67.4)	0.98 (0.82, 1.18)
$15000–$24999	1,054	14.1 (12.4, 16.0)	470	38.5 (3.02, 45.4)	577	61.5 (54.6, 68.0)	1.07 (0.94, 1.21)
$25000–$49999	1,858	20.8 (19.0, 22.8)	838	43.9 (38.9, 49.1)	1,001	56.1 (50.9, 61.1)	0.95 (0.84, 1.06)
$50000–$74999	1,467	16.1 (14.5, 17.8)	660	44.7 (39.4, 50.2)	799	55.3 (49.8, 60.6)	0.92 (0.82, 1.03)
≥$75000	2,967	37.1 (34.8, 39.6)	1,376	42.9 (39.1, 46.8)	1,569	57.1 (53.2, 60.9)	*ref*
Health care access and use							
Health insurance							
No insurance	297	3.8 (3.0, 4.9)	145	48.7 (36.6, 61.0)	148	51.3 (39.0, 63.4)	0.95 (0.75, 1.20)
Partial year coverage	417	5.6 (4.1, 7.4)	151	31.0 (19.9, 45.0)	259	69.0 (55.0, 80.1)	1.21 (0.99, 1.49)
Full year coverage	7,743	90.6 (88.6, 92.3)	3,524	43.8 (41.3, 46.3)	4,167	56.2 (53.7, 58.7)	*ref*
Routine care visit	5,894	73.4 (71.3, 75.4)	2200	36.1 (33.3, 39.1)	3,651	63.9 (60.9, 66.7)	*NA*

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Characteristics	Survey respondents[1]		No asthma attack in past year		≥1 asthma attack in past year		
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	aPR[2] (95% CI)
ED visit	1,125	16.2 (14.4, 18.2)	140	11.7 (8.0, 16.6)	981	88.3 (83.4, 92.0)	*NA*
Urgent care visit	2501	35.4 (32.9, 37.9)	466	20.8 (16.8, 25.6)	2,019	79.2 (74.4, 83.2)	*NA*
Hospitalization	193	3.0 (2.2, 4.1)	21	12.4 (5.0, 27.3)	172	87.6 (72.7, 95.0)	*NA*
Long-term control medications[4]	3,677	43.6 (41.2, 46.1)	1,319	32.2 (29.1, 35.6)	2,335	67.8 (64.4, 70.9)	**1.39 (1.28, 1.51)**
Cost as a barrier							
Medication cost	574	8.3 (6.8, 10.0)	169	33.1 (23.3, 44.6)	398	66.9 (55.4, 76.7)	*NA*
Primary care physician visit cost	328	4.2 (3.5, 5.2)	101	32.8 (24.1, 42.9)	224	67.2 (57.1, 75.9)	*NA*
Specialist visit cost	200	3.0 (2.2, 4.0)	60	27.4 (17.1, 40.9)	139	72.6 (59.1, 82.9)	*NA*
Any cost barrier[4]	784	10.9 (9.3, 12.7)	244	34.7 (26.6, 43.8)	532	65.3 (56.2, 73.4)	**1.14 (1.00, 1.31)**

Abbreviations: N, Sample size; CI, 95% confidence interval; ED, emergency department

[1] Numbers within selected characteristics may not sum to total due to missing responses

[2] The adjusted prevalence ratio compares prevalence of people with one or more asthma attacks in the past year among category subgroups. Adjusted for age, sex, race/ethnicity, household income, health care coverage, cost as barrier to medical care, and long-term control meds.

[3] Income was missing for 5.6% (survey respondents) and 5.2% (uncontrolled asthma) and 4.7% (at least one asthma attack in past year) participants.

[4] The reference value for these characteristics are “do not use long-term control medications” and “no cost barriers,” respectively.

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Table 3.

Weighted percentages and adjusted prevalence ratios of quality of life measures and health care use, by asthma control and asthma attack status among children aged 5–17 years with current asthma: Behavioral Risk Factor Surveillance System Asthma Call-back Survey, 2006–2010

	Quality of life measures				Health Care Use			
	Activity limitation[1]		≥1 missed school days[1]		ED visit in past year[1]		Hospitalization in past year[1]	
Characteristics	**Unadjusted % (95% CI)**	**Adjusted[2] PR (95% CI)**	**Unadjusted % (95% CI)**	**Adjusted[2] PR (95% CI)**	**Unadjusted % (95% CI)**	**Adjusted[2] PR (95% CI)**	**Unadjusted % (95% CI)**	**Adjusted[2] PR (95% CI)**
Total	61.6 (59.2, 63.9)		49.8 (47.2, 52.3)		16.2 (14.4, 18.2)		3.0 (2.2, 4.1)	
Asthma control status								
Uncontrolled	78.5 (75.0, 81.6)	**1.43 (1.33, 1.54)**	66.0 (62.3, 69.5)	**1.45 (1.32, 1.59)**	27.1 (23.3, 31.2)	**2.05 (1.62, 2.59)**	5.8 (3.9, 8.5)	**2.38 (1.22, 4.64)**
Well controlled	51.8 (48.8, 54.8)	*Ref*	40.2 (37.2, 43.3)	*Ref*	10.0 (8.3, 12.0)	*Ref*	1.4 (0.8, 2.4)	*Ref*
≥1 asthma attack in past year								
Yes	76.4 (73.6, 79.1)	**1.74 (1.59, 1.91)**	61.8 (58.5, 65.0)	**1.68 (1.50, 1.89)**	25.4 (22.5, 28.5)	**4.78 (3.27, 6.99)**	4.7 (3.3, 6.5)	**3.64 (1.48, 8.97)**
No	42.0 (38.3, 45.8)	*ref*	33.9 (30.1, 37.9)	*ref*	4.4 (3.0, 6.4)	*ref*	0.9 (0.3, 2.1)	*ref*

[1]Activity limitation, missed school days, ED or Urgent care center visit in past year, and hospitalization in past year because of asthma.

[2]Adjusted for age, sex, race/ethnicity, household income, health care coverage, cost as barrier to medical care, and long-term control meds.