Long-term control medication use and asthma control status among children and adults with asthma

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Abstract

Background—Uncontrolled asthma decreases quality of life and increases health care use. Most people with asthma need daily use of long-term control (LTC) medications for asthma symptoms and to prevent asthma attacks. Ongoing assessment of a person's level of asthma control and medication use is important in determining the effectiveness of current treatment to decrease frequency and intensity of symptoms and functional limitations.

Objective—To assess the use of LTC medication among children and adults with current asthma and identify contributing factors for LTC medication use.

Methods—We used the 2006–2010 Behavioral Risk Factor Surveillance System (BRFSS) child and adult Asthma Call-back Survey (ACBS) data to assess level of asthma control and LTC medication use. Asthma control was classified as well-controlled and uncontrolled using guideline-based measures. We used multivariable logistic regression models to identify contributing factors for LTC medication use and having uncontrolled asthma.

Results—Among persons with current asthma, 46.0% of children and 41.5% of adults were taking LTC medications and 38.4% of children and 50.0% of adults had uncontrolled asthma.

Among children who had uncontrolled asthma (38.4%), 24.1% were taking LTC medications and 14.3% were not taking LTC medications. Among adults who had uncontrolled asthma (50.0%), 26.7% were taking LTC medications and 23.3% were not taking LTC medications.

Conclusions—Using BRFSS ACBS data to assess the level of asthma control and LTC medication use can identify subpopulations of persons with asthma who receive suboptimal treatment, for which better asthma-related medical treatment and management are needed.

Keywords

Epidemiology; Control; management; Therapy; Pediatrics

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Introduction

Asthma affects nearly 26 million people, including 7.0 million children [1]. For most people with asthma, daily use of medications for long-term control (LTC) of symptoms is the cornerstone of care in controlling asthma symptoms and preventing recurrent exacerbations of asthma [2]. The level of asthma control, described by the frequency and intensity of symptoms and functional limitations, is a function of underlying severity, responsiveness to treatment, and adequacy of asthma care and management. Treatment for asthma is generally tailored to severity and further adjusted based on the level of control [2]. In addition to socioeconomic and environmental factors [3–5], non-adherence to treatment, suboptimal treatment, or resistance to treatment [6–10] can affect the level of asthma control. A systematic literature review indicates that adherence to treatment was associated with fewer severe asthma exacerbations [9]. Uncontrolled asthma lead to decreased quality of life and increased health care use [11,12]. Therefore, the ongoing assessment of a person's level of asthma control and medication use is essential in determining the effectiveness of current treatment in decreasing frequency and intensity of symptoms and functional limitations [2]. Although previous studies provided population-based estimates of asthma control levels and use of LTC medications among children and adults with asthma [13–15], limited information is available on population-based estimates of LTC medications use by level of asthma control among children and adults with uncontrolled asthma.

In this study, we aim to answer the following research questions: "Do all persons with uncontrolled asthma use LTC medications as recommended" and if not, "what are the contributing factors for LTC medication use." We assessed the use of LTC medication and identify contributing factors for its use among children and adults with uncontrolled asthma in the states that participated in the Centers for Disease Control and Prevention (CDC) Behavioral Risk Factor Surveillance System (BRFSS) Asthma Call-back Survey (ACBS). To provide information on the study population, those with uncontrolled asthma, we also assessed uncontrolled asthma status among adults and children with current asthma. We used impairment measures adapted from the National Asthma Education and Prevention Program (NAEPP) 2007 guidelines to determine the level of asthma control [2,13,14].

Methods

Survey Data description

Similar to our previous publication [13], we used 5 years of BRFSS child and adult ACBS data (2006–2010) to obtain stable estimates. We analyzed child and adult ACBS data separately because CDC's BRFSS collects and maintains the data separately. Our study included children (aged 0–17 years) from 35 states and adults (aged 18 years and older) from 40 states and the District of Columbia.

The Air Pollution and Respiratory Health Branch (APRHB) of CDC's National Center for Environmental Health (NCEH) developed and funds the BRFSS ACBS. The ACBS has been used as a follow-up survey to the BRFSS since 2006. Although BRFSS is a state-based, random-digit–dialed telephone survey of non-institutionalized U.S. adults, it contains a Random Child Selection module and a Child Asthma Prevalence module. Both modules

were used in participating states to identify households with a child who had asthma to administer the child ACBS. BRFSS respondents or proxy servers who report a child ever being 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 or attacks, self-management education, health care use and access, medication use, comorbidities, and environmental allergens and irritants [16]. The ACBS response rate for children and adults varies by state and year. During 2006–2010, the median ACBS response rates ranged from 47.6% to 53.7% for children (via adult proxies) and from 47.5% to 54.3% for adults. 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 distribution, and disproportionate nonresponse [16]. In addition, the combined 2006–2010 child and adult data files were proportionally re-weighted for each state to account for differences in sample size by year and the number of years each state participated. More information on participating states, weight calculation, and the response rate can be found in the ACBS Summary Data Quality Report for each year at http://www.cdc.gov/brfss/acbs [16].

Variables

Participants were asked, "Have you ever been told by a doctor, nurse, or other health professional that you (the child) had asthma?" and "Do you (the child) still have asthma?" [1]. Respondents who answered "yes" to both questions were considered to have current asthma. This is consistent with the methodology used with previous CDC publications.

Level of asthma control was classified as well-controlled and uncontrolled asthma using three impairment measures: daytime symptoms, night-time symptoms, and use of short-acting β_2 agonists for symptom control (not for prevention of exercise-induced bronchospasm). Respondents were assigned to each category based on their most impaired level among the three impairment measures [2,13,14,17]. This is an adaptation of the 2007 NAEPP guidelines because the ACBS did not include all required measures for current impairment (eg, pulmonary function measures) and for future risk assessment (eg, asthma exacerbations, progressive decline in lung function in adults, or reduced lung growth in children) [2,17]. We did not include one of the impairment measures, interference with normal activities, because the reference time for the question was the past 12 months and should only include more recent experiences [17]. We categorized persons with current asthma into four subgroups based on their level of asthma control and long-term controlled (LTC) medication use: well-controlled asthma and taking LTC medications; well-controlled asthma and not taking LTC medications; uncontrolled asthma and taking LTC medications; and uncontrolled asthma and not taking LTC medications. Qualifying LTC asthma medications included inhaled corticosteroids, systemic corticosteroids, long-acting β_2 agonist, leukotriene receptor antagonists, methylxanthines, and immunomodulators. For the analyses, we combined responses for all subgroups of LTC asthma medications because of small sample sizes for the subgroups.

For children and adults, analysis variables included demographic characteristics (age, sex, race/ethnicity), annual household income, health care coverage, and routine medical care visits. For adults, body mass index (BMI) (defined as weight in kilograms divided by height in squared meter; obese = BMI 30) was considered in the analysis. The presence of chronic obstructive pulmonary disease (COPD), depression, and smoking status were also included in the analysis for adults. The COPD variable includes responses to the question asking, "Have you ever been told by a doctor or other professional that you have emphysema/ chronic bronchitis/COPD?"

Statistical analysis

We analyzed data using SAS-callable SUDAAN (version 11.0, RTI International, Research Triangle Park, NC) to account for the complex sampling design of the BRFSS ACBS. During the analyses, sample weights were used to produce estimates generalizable to a participating state's population. We assessed LTC asthma medication use and identified contributing factors among children and adults with uncontrolled asthma. To provide information on the study population, we assessed uncontrolled asthma status among adults and children with current asthma similar to our previous publication [13]. We used the chi-square test to test for group differences and multivariable logistic regression to test for associations between response variable (dependent variable) and independent variables. We also calculated weighted percent estimates, adjusted prevalence ratios (aPRs) (predicted marginal risk ratio), and 95% confidence intervals (CI). The aPR is considered statistically significant if 95% CI does not include the null value of 1. All aPRs for children and adults were adjusted for age, sex, race/ethnicity, annual household income, health care coverage, and routine care visits. In addition, prevalence ratios for adults were adjusted for smoking, BMI, COPD, and depression. Statistical significance was determined as a $p < 0.05$ by a non-directional z-test or by non-overlapping 95% CIs. Terms such as "higher than," "less than," "more likely," and "less likely" indicate a statistically significant difference. Terms such as "similar" and "no difference" indicate differences that are not statistically significant. Relative standard error (RSE), defined as standard error divided by prevalence estimate, was used as a measure of an estimate's reliability (an RSE < 0.30 indicates a "reliable" estimate) [18].

Results

Children with current asthma

Characteristics—In the combined 2006–2010 BRFSS ACBS survey sample, 9697 children had current asthma.

Most of the children with current asthma were male (57.0%) and non-Hispanic white (57.2%). By age, 18.3% of children with asthma were aged 0–4 years, 43.5% were aged 5–11 years, and 38.2% were aged 12–17 years. Among children with asthma, 11.7% lived in homes with annual household incomes of less than $15 000. Of children with asthma, 96.4% had health care coverage, and 74.6% had routine medical care visits, 46.0% (24.1% of children with uncontrolled asthma and 21.9% of children with well-controlled asthma) were taking LTC asthma medications, and 38.4% had uncontrolled asthma.

Among children with asthma who had uncontrolled asthma (38.4%), 24.1% were taking LTC medications and 14.3% were not taking LTC medications (Table 1). Among children with asthma who had well-controlled asthma (61.6%), 21.9% were taking LTC medications and 39.7% were not taking LTC medications (Table 2).

Factors associated with asthma control among children with current asthma

—Prevalence of uncontrolled asthma was higher among children aged 0–4 years with asthma (47.3%; aPR = 1.3 [1.1–1.5]) and among those with one or more routine medical care visits (44.7%; aPR = 2.2 [1.8–2.6]) than those aged 12–17 years (34.8%) and those without routine medical care visits (20.6%), respectively (Table 1).

Factors associated with LTC medication use among children with uncontrolled asthma

—Among children with uncontrolled asthma, children aged <12 years (0–4 years: aPR = 1.4 [1.2–1.6]; 5–11 years: aPR = 1.3 [1.2–1.5]) were more likely to use LTC medications than children aged 12–17 years. Also, children with routine care visits (aPR = 1.3 [1.1–1.6]) were more likely to use LTC medications than children who did not have routine care visits. Children with annual household income of <$15 000 were less likely (aPR = 0.7 [0.5–0.9]) to use LTC medications for asthma than children with household income of $75 000. Sex, race/ethnicity, and health care coverage status were not associated with uncontrolled asthma and LTC medication use (Table 1).

Adults with current asthma

Characteristics

—In the combined 2006–2010 BRFSS ACBS sample, 52210 adults had current asthma.

Most of the adults with current asthma were female (63.1%) and non-Hispanic whites (74.6%). Among adults with current asthma, 30.7% were aged 18–34 years, 18.5% were aged 35–44 years, 19.6% were aged 45–54 years, 15.9% were aged 55–64 years, and 15.3% were aged 65 years. Also, 14.7% had annual household incomes of <$15 000, 86.9% had health care coverage, 55.2% reported having one or more routine medical care visits, 19.5% were current smokers, 39.4% were obese, 34.6% had COPD, 34.7% had depression, 41.5% were taking LTC asthma medications (26.7% of adults with uncontrolled asthma and 14.8% of adults with well-controlled asthma), and 50.0% had uncontrolled asthma (Table 3). Among adults with asthma who had uncontrolled asthma (50.0%), 26.7% were taking LTC medications and 23.3% were not taking LTC medications (Table 3). Among adults with asthma who had well-controlled asthma (50.0%), 14.8% were taking LTC medications and 35.2% were not taking LTC medications (Table 2).

Factors associated with asthma control among adults with current asthma—

The prevalence of uncontrolled asthma was similar among each of the sex, age, and race/ethnicity groups; however, the prevalence decreased as annual household income increased. The prevalence estimates ranged from 66.2% among adults with annual household income of less than $50000 to 38.1% among adults with household income of $75000. Prevalence of uncontrolled asthma was higher among adults without health care coverage (54.7%) and those having routine medical care visits (60.4%). Uncontrolled asthma was also higher

among adults who were current smokers (64.8%), had COPD (66.3%), or had depression (58.9%), compared with those without these conditions. Adjusting for covariates (age, sex, race/ethnicity, health care coverage, routine medical care visits, smoking status, BMI status, COPD, depression) did not alter these associations. There was a statistically significant association between asthma control status and obesity status prior to adjusting for the aforementioned covariates; however, this association did not remain significant after the adjustment. Uncontrolled asthma prevalence was 54.8% among obese adults and 46.6% among non-obese adults and aPR was 1.1 [1.0–1.1]) (Table 3).

Factors associated with LTC medication use among adults with uncontrolled asthma—Among adults with uncontrolled asthma, LTC medication use was significantly associated with being aged 35 years (35–44: 21.7%, aPR = 1.2 [1.1–1.3]; 45–54: 23.4%, aPR = 1.2 [1.1–1.4]; 55–64: 21.6%, aPR = 1.3 [1.2–1.4]; 65: 21.7%, aPR = 1.3 [1.2–1.4]), compared with the adults aged 18–34 years. Although prevalence of uncontrolled asthma did not differ by sex or race/ethnicity, Hispanics with uncontrolled asthma were less likely to take LTC medications than non-Hispanic whites (21.8% vs. 27.4%; aPR = 0.8 [0.7–0.9]) (Table 3). LTC medication use also was more prevalent among adults with heath care coverage (28.0%) and those having routine medical care visits (38.6%) than the corresponding reference groups (no heath care coverage [19.1%] and no routine medical care visits [11.6%]). Adjusting for covariates did not alter these associations. Adults with uncontrolled asthma who smoked were less likely to take LTC medications (26.5%) than those who never smoked (24.0%) (aPR = 0.8 [0.7–0.8]). In addition, the associations between LTC use and annual household income, being obese, having COPD, or having depression were statistically significant before the adjustment, but not after the adjustment (Table 3).

Discussion

We assessed the use of LTC medications for asthma control among children and adults with current asthma and identified factors associated with the medication use by analyzing 2006–2010 BRFSS ACBS data from participating states. We identified four distinct subgroups of people with asthma based on their levels of asthma control and LTC medication use. Our findings show that not all children and adults who had uncontrolled asthma were taking LTC medications (14.3% and 23.3%, respectively) and not all who were taking LTC had their asthma controlled: 24.1% of children and 26.7% of adults with asthma were taking LTC medications but had uncontrolled asthma. Possible explanations for these findings are suboptimal treatment [6], non-adherence to treatment regimens for various reasons [8–10], resistance to treatment [7], or that providers are not following the NAEPP 2007 guidelines [2].

According to the NAEPP 2007 guidelines, all persons with uncontrolled asthma should be taking/prescribed LTC medications, and their treatment regimen should be adjusted periodically based on the level of asthma control [2]. Those with uncontrolled asthma who are not taking LTC medications need a treatment regimen that includes LTC medications. Those who are taking LTC but still have uncontrolled asthma should have their treatment regimen (type and dose of medications) adjusted [2]. Treating those with uncontrolled

asthma with LTC medications appropriately, as defined in the NAEPP 2007 guidelines, is an important component of asthma management.

The findings of this study are similar to the findings of previous publications [13–15] and state-specific reports [19], which indicate that socio-economic and demographic factors affect the prevalence of asthma control and medication use. For children and adults with asthma, age and routine care visits were strong predictors of asthma control and medication use. Among children with uncontrolled asthma, being aged 0–4 or 5–11 years, or having routine care visits were predictors of LTC use, and having <$15 000 annual household income was predictor of not using of LTC medication. Among adults with uncontrolled asthma, being aged 35 years, having routine care visits, or having health care coverage was significantly associated with medication use, whereas being a smoker or being a Hispanic was associated with not using medication. Having less than $50 000 annual household income or having comorbid conditions (obesity, COPD, or depression) were significantly associated with having uncontrolled asthma but were not associated with medication use.

Some of these associations are intuitive and expected based on previous publications [13–15]. For example, persons having health coverage and routine medical care visits might have a greater chance of being diagnosed and treated. Although higher uncontrolled asthma prevalence among smokers might be explained by smoking which could impair the effect of inhaled corticosteroids, (the most commonly used LTC medications for controlling asthma) [20], we cannot explain our finding of smokers being less likely to be LTC medication users. This might warrant further investigation. In addition, despite controlling for income and health care coverage, being Hispanic was still significantly associated with not taking LTC medications. This might indicate the presence of other risk factors in this population and warrants further investigation. Identifying modifiable predictors (low income, not having health care coverage, smoking, or comorbid conditions) of uncontrolled asthma and medication use is an important step in developing targeted interventions and producing strategies that promote better asthma care and improve the health and well-being of persons with asthma and their families.

The strength of this study is the ability to assess the level of asthma control and LTC medication use among a large sample of children and adults with current asthma from states participating in the ACBS. The ACBS is the only survey that has data for guideline-based classification of asthma control [2] and identifies those taking LTC medications to evaluate population-based asthma control status and medication use.

This study has several limitations. First, the indicators for asthma control classification available in the ACBS circumscribed our findings. We were unable to include all of the specified elements from the NAEPP guidelines because of the nature of telephone surveys and the content of the ACBS questionnaire. Those missing elements included activity limitation, pulmonary function measures, asthma exacerbations that require oral corticosteroid, and lung growth status in children [2]. This limitation might alter asthma control prevalence estimates. However, it will not affect the assessment of LTC medication use because ACBS provides very detailed information on asthma medications, regardless of asthma control status. The definition of asthma control used here also is consistent with the

definition in other reports of population-based estimates [13,14,19]. Another limitation is that the ACBS response rates for the participating states were around 50%. Low response rates might affect the results by introducing non-response bias, if survey respondents differed from non-responders on the characteristics studied. However, the BRFSS sampling and weighting procedures and varying response rates among states over the 5-year study period can minimize non-response effects on the results [16]. In addition, because of the cross-sectional nature of the survey data, we could not generally determine temporal sequence or causality. Finally, the findings cannot be generalized to people with current asthma in states that did not participate in the ACBS.

Conclusion

Despite national guidelines for managing asthma and available advanced medical treatments, not all children and adults with uncontrolled asthma were taking LTC medication and not all who were taking LTC medication had their asthma under control. Among children and adults with asthma who were taking LTC medications, 21.9% of children and 14.8% of adults had well-controlled asthma and about 20% of children and adults had uncontrolled asthma. Our findings indicate that multiple factors were significantly associated with either having uncontrolled asthma or taking LTC asthma medications. Those factors included age, routine care visits, low income, health care coverage, tobacco smoking, and co-morbid conditions including obesity, COPD, and depression. Development of targeted interventions or strategies aimed at reducing modifiable risk factors (low income, not having health care coverage, smoking, or comorbid conditions) can lead to better asthma control and improve the health and quality of life of people with asthma.

Acknowledgments

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Table 1

Prevalence of uncontrolled asthma[a] and long-term control (LTC) asthma medication use among children (aged 0–17 years) with current asthma[b] by selected characteristics—Behavioral Risk Factor Surveillance System Asthma Call-back Survey, 2006–2010

Characteristics	All Respondents	Uncontrolled asthma (n = 3534)	Asthma control status as the response variable	Uncontrolled asthma & taking LTC medication (n = 2182)	Uncontrolled asthma & not taking LTC medication (n = 1352)	LTC medication as the response variable
	No.[c] (% [d])	Unadjusted Percentage % [d] (95% CI[d])	Adjusted Prevalence Ratio aPR[e] (95% CI[e])	Unadjusted Percentage % [d] (95% CI[d])	Unadjusted Percentage % [d] (95% CI[d])	Adjusted Prevalence Ratio aPR[f] (95% CI[f])
Total	9697 (100)	38.4 (36.2–40.8)	—	24.1 (22.3–26.1)	14.3 (12.6–16.2)	—
Sex		p^g = 0.0568		p^h = 0.1628	p^h = 0.1628	
Male	5536 (57.0)	36.5 (33.6–39.5)	Referent	23.1 (20.8–25.7)	13.3 (11.3–15.7)	Referent
Female	4126 (43.0)	41.0 (37.5–44.6)	1.2 (1.0–1.3)	25.5 (22.5–28.6)	15.5 (12.7–18.8)	1.0 (0.9–1.1)
Age, years		p = 0.0019		p = 0.0000	p = 0.0000	
0–4	1213 (18.3)	47.3 (41.3–53.3)	1.3 (1.1–1.5)	32.1 (27.1–37.7)	15.1 (11.3–19.9)	1.4 (1.2–1.6)
5–11	3746 (43.5)	38.0 (34.7–41.4)	1.0 (0.9–1.2)	26.0 (23.0–29.2)	12.0 (10.2–14.1)	1.3 (1.2–1.5)
12–17	4738 (38.2)	34.8 (31.3–38.4)	Referent	18.2 (15.9–20.8)	16.6 (13.3–20.4)	Referent
Race/Ethnicity[i]		p = 0.0130		p = 0.0201	p = 0.0201	
White, NH	6472 (57.2)	37.1 (34.5–39.7)	Referent	25.4 (23.1–27.8)	11.7 (10.2–13.4)	Referent
Black, NH	991 (15.9)	46.3 (39.8–53.0)	1.1 (1.0–1.3)	24.9 (20.4–30.1)	21.5 (15.4–29.1)	0.8 (0.7–1.0)
Hispanic	971 (16.9)	41.0 (34.1–48.1)	1.0 (0.9–1.3)	22.6 (17.1–29.3)	18.3 (13.0–25.2)	0.8 (0.7–1.0)
Other race, NH	904 (10.0)	30.7 (24.3–38.0)	0.8 (0.7–1.0)	20.8 (15.3–27.7)	9.9 (6.9–14.0)	1.0 (0.8–1.2)
Household income		p = 0.0063		p = 0.0151	p = 0.0151	
<$15 000	811 (11.7)	50.8 (41.6–59.9)	1.2 (1.0–1.5)	22.5 (16.3–30.1)	28.3 (19.1–39.8)	0.7 (0.5–0.9)
$15 000–$24 999	1223 (14.5)	41.0 (34.8–47.5)	1.0 (0.8–1.2)	25.7 (20.3–32.1)	15.3 (11.8–19.5)	0.9 (0.8–1.1)
$25 000–$49 999	2103 (21.0)	38.6 (34.3–43.1)	1.0 (0.8–1.1)	25.4 (21.6–29.6)	13.2 (10.9–16.0)	1.0 (0.8–1.1)
$50 000–$74 999	1684 (16.6)	30.9 (26.3–35.9)	0.8 (0.7–1.0)	20.1 (16.6–24.2)	10.8 (8.0–14.5)	0.9 (0.8–1.1)
$75 000	3351 (36.1)	36.9 (33.4–40.5)	Referent	25.9 (22.7–29.5)	10.9 (9.0–13.2)	Referent
Health care coverage in past 12 months		p = 0.9317		p = 0.0033	p = 0.0033	
Yes	9342 (96.4)	38.5 (36.2–40.9)	0.9 (0.7–1.2)	24.6 (22.7–26.7)	13.9 (12.2–15.9)	1.5 (1.0–2.3)

	All Respondents	Uncontrolled asthma (n = 3534) Unadjusted Percentage	Asthma control status as the response variable Adjusted Prevalence Ratio	Uncontrolled asthma & taking LTC medication (n = 2182) Unadjusted Percentage	Uncontrolled asthma & not taking LTC medication (n = 1352) Unadjusted Percentage	LTC medication as the response variable Adjusted Prevalence Ratio
No	332 (3.6)	38.0 (28.1–49.2)	Referent	13.0 (8.1–20.3)	25.0 (16.4–36.2)	Referent
		$p = 0.0000$		$p = 0.0000$	$p = 0.0000$	
Routine care visits (one or more)						
Yes	6863 (74.6)	44.7 (41.9–47.5)	2.2 (1.8–2.6)	28.9 (26.6–31.4)	15.7 (13.6–18.2)	1.3 (1.1–1.6)
No	2709 (25.4)	20.6 (17.4–24.1)	Referent	10.2 (7.8–13.3)	10.4 (8.3–12.8)	Referent

CI, confidence interval; NH, non-Hispanic.

[a] Defined as the most impaired level from the one or more individual elements (i.e., daytime and nighttime symptoms in past 30 days and rescue medication use in past 3 months).

[b] Persons who answered "yes" to the questions, "Have you ever been told by a doctor or other health professional that you had asthma?" and "Do you still have asthma?"

[c] Unweighted pooled sample size, 2006–2010. Individual characteristic categories might not sum to total because of item non-response.

[d] Weighted prevalence or 95% CI.

[e] Logistic regression model results (prevalence ratio) with uncontrolled asthma as the response variable.

[f] Logistic regression model results (prevalence ratio) with long-term asthma control medication use as the response variable among children with uncontrolled asthma.

[g] $P < 0.05$ for the chi-square test of association between asthma controlled status and selected variables.

[h] $P < 0.05$ for the chi-square test of association between asthma controlled status, long-term asthma control medication use and selected variables.

[i] Race categories "white, non-Hispanic" and "black, non-Hispanic" include persons who indicated only a single race group. "Other races, non-Hispanic" includes Asian, American Indian Alaskan Native, Native Hawaiian and Other Pacific Islander, persons reporting more than one race, and persons reporting their race as something other than those listed here.

Table 2

Prevalence of well-controlled asthma[a] and long-term control (LTC) asthma medication use among children (0–17 years) and adults (≥18 years) with current asthma[b] by selected characteristics—Behavioral Risk Factor Surveillance System Asthma Call-back Survey, 2006–2010

Characteristics	Children: Well-controlled asthma (n = 6163)			Adults: Well-controlled asthma (n = 24 378)		
	Overall (n = 6163) %[d] (95% CI[d])	Taking LTC medication (n = 2150) %[d] (95% CI[d])	Not taking LTC medication (n = 4013) %[d] (95% CI[d])	Overall (n = 24 378) %[d] (95% CI[d])	Taking LTC medication (n = 8698) %[d] (95% CI[d])	Not taking LTC medication (n = 15 680) %[d] (95% CI[d])
Total	61.6 (59.3–63.2)	21.9 (20.0–23.9)	39.7 (37.4–41.9)	50.0 (49.0–51.0)	14.8 (14.2–15.5)	35.2 (34.2–36.2)
Sex						
Male	63.5 (60.5–66.4)	24.7 (22.0–27.7)	38.8 (35.9–41.8)	53.1 (51.0–55.1)	15.3 (14.1–16.7)	37.8 (35.8–39.8)
Female	59.0 (55.4–62.5)	18.1 (15.7–20.7)	41.0 (37.5–44.5)	48.2 (47.0–49.3)	14.5 (13.8–15.2)	33.7 (32.6–34.8)
Age, years						
0–4	52.7 (46.7–58.8)	24.6 (19.0–31.2)	28.2 (23.2–33.7)	NA	NA	NA
5–11	62.0 (58.6–65.3)	24.1 (21.3–27.2)	37.9 (34.6–41.4)	NA	NA	NA
12–17	65.2 (61.6–68.7)	18.1 (15.8–20.6)	47.2 (43.7–50.6)	NA	NA	NA
18–34	NA	NA	NA	56.9 (54.3–59.4)	10.2 (8.9–11.7)	46.6 (44.0–49.2)
35–44	NA	NA	NA	52.7 (50.3–55.0)	14.0 (12.7–15.6)	38.6 (36.3–40.9)
45–54	NA	NA	NA	47.0 (45.3–47.8)	16.4 (15.1–17.8)	30.6 (29.0–32.3)
55–64	NA	NA	NA	44.5 (42.8–46.1)	17.1 (15.9–18.4)	27.4 (25.9–28.9)
≥65	NA	NA	NA	42.5 (41.0–44.1)	20.4 (19.1–21.7)	22.2 (20.9–23.5)
Race/Ethnicity[e]						
White, NH	62.9 (60.3–65.5)	24.2 (21.7–26.9)	38.7 (36.2–41.3)	50.5 (49.3–51.6)	15.9 (15.2–16.7)	34.5 (33.4–35.7)
Black, NH	53.7 (47.0–60.2)	16.0 (12.1–20.9)	37.6 (31.8–43.9)	47.7 (44.1–51.4)	11.6 (9.7–13.7)	36.2 (32.7–39.9)
Hispanic	59.0 (51.9–65.9)	22.2 (16.9–28.7)	36.8 (30.5–43.7)	49.8 (44.4–54.1)	11.4 (9.2–13.9)	38.4 (34.2–42.8)
Other race, NH	69.3 (62.0–75.7)	18.2 (13.3–24.5)	51.0 (42.9–59.1)	48.7 (44.1–53.4)	11.6 (9.2–14.2)	37.2 (32.5–42.2)

CI, confidence interval; NH, non-Hispanic; NA, not applicable.

[a] Defined as the most impaired level from the one or more individual elements (i.e., daytime and nighttime symptoms in past 30 days and rescue medication use in past 3 months).

[b] Persons who answered "yes" to the questions, "Have you ever been told by a doctor or other health professional that you had asthma?" and "Do you still have asthma?"

[c] Unweighted pooled sample size, 2006–2010. Individual characteristic categories might not sum to total because of item non-response.

[d] Weighted prevalence or 95% CI.

[e] Race categories "white, non-Hispanic" and "black, non-Hispanic" include persons who indicated only a single race group. "Other races, non-Hispanic" includes Asian, American Indian or Alaskan Native, Native Hawaiian and Other Pacific Islander, persons reporting more than one race, and persons reporting their race as something other than those listed here.

Table 3

Prevalence of uncontrolled asthma[a] and long-term control (LTC) asthma medication use among adults (≥18 years) with current asthma[b] by selected characteristics—Behavioral Risk Factor Surveillance System Asthma Call-back Survey, 2006–2010

Characteristics	All Respondents	Uncontrolled asthma (n = 27 832)	Asthma control status as the response variable	Uncontrolled asthma & taking LTC medication (n = 16 088)	Uncontrolled asthma & not taking LTC medication (n = 11 744)	LTC medication as the response variable
	No.[c] (%[d])	Unadjusted Percentage %[d] (95% CI[d])	Adjusted Prevalence Ratio aPR[e] (95% CI[e])	Unadjusted Percentage %[d] (95% CI[d])	Unadjusted Percentage %[d] (95% CI[d])	Adjusted Prevalence Ratio aPR[f] (95% CI[f])
Total	52 210	50.0 (49.0–51.1)	—	26.7 (25.9–27.6)	23.3 (22.4–24.2)	—
Sex		p^g = 0.0000		p^h = 0.0000	p^h = 0.0000	
Male	13 760 (36.9)	46.9 (44.9–49.0)	Referent	23.0 (21.4–24.7)	23.9 (22.2–25.7)	Referent
Female	38 450 (63.1)	51.8 (50.7–53.0)	1.0 (1.0–1.1)	28.9 (27.9–29.9)	22.9 (22.0–23.9)	1.1 (1.0–1.2)
Age, years		p = 0.0000		p = 0.0000	p = 0.0000	
18–34	5617 (30.7)	43.1 (40.6–45.7)	Referent	17.2 (15.3–19.3)	26.0 (23.7–28.3)	Referent
35–44	6821 (18.5)	47.3 (45.0–49.7)	1.0 (1.0–1.1)	25.6 (23.6–27.8)	21.7 (19.9–23.6)	1.2 (1.1–1.3)
45–54	11 416 (19.6)	53.0 (51.2–54.8)	1.1 (1.0–1.1)	29.6 (27.9–31.2)	23.4 (22.0–24.9)	1.2 (1.1–1.4)
55–64	13 509 (15.9)	55.5 (53.9–57.2)	1.1 (1.0–1.1)	33.9 (32.4–35.6)	21.6 (20.3–22.9)	1.3 (1.2–1.4)
≥65	14 643 (15.3)	57.5 (55.9–59.0)	1.1 (1.0–1.2)	35.8 (34.4–37.3)	21.7 (20.4–22.9)	1.3 (1.2–1.4)
Race/Ethnicity[i]		p = 0.5078		p = 0.0058	p = 0.0058	
White, NH	42 517 (74.6)	49.5 (48.4–50.7)	Referent	27.4 (26.4–28.3)	22.2 (21.3–23.1)	Referent
Black, NH	3236 (9.7)	52.3 (48.6–55.9)	1.0 (0.9–1.1)	26.8 (23.9–29.9)	25.5 (22.3–29.0)	0.9 (0.8–1.0)
Hispanic	2342 (9.0)	50.2 (45.9–54.6)	1.0 (0.9–1.1)	21.8 (18.5–25.6)	28.4 (24.6–32.6)	0.8 (0.7–0.9)
Other race, NH	3656 (6.7)	51.3 (46.6–55.9)	1.0 (0.9–1.1)	25.7 (22.3–29.5)	25.5 (22.1–29.3)	0.9 (0.9–1.1)
Household income		p = 0.0000		p = 0.0000	p = 0.0000	
<$15 000	8146 (14.7)	66.2 (63.5–68.7)	1.4 (1.3–1.5)	34.2 (31.6–36.9)	31.9 (29.5–34.5)	0.9 (0.9–1.0)
$15 000–$24 999	8967 (16.7)	60.6 (57.8–63.4)	1.3 (1.2–1.4)	30.3 (27.9–32.8)	30.4 (27.9–32.9)	0.9 (0.8–1.0)
$25 000–$49 999	12 351 (23.8)	51.5 (49.5–53.6)	1.2 (1.1–1.3)	26.3 (24.7–28.0)	25.2 (23.4–27.1)	0.9 (0.9–1.0)
$50 000–$74 999	7143 (15.1)	44.7 (42.2–47.3)	1.1 (1.0–1.2)	25.9 (23.8–28.2)	18.8 (16.8–20.9)	1.0 (0.9–1.1)
≥$75 000	10 428 (29.7)	38.1 (36.1–40.1)	Referent	22.7 (21.1–24.4)	15.4 (14.0–17.0)	Referent

Characteristics	All Respondents No.[c] (%[d])	Uncontrolled asthma (n = 27 832) Unadjusted Percentage %[d] (95% CI[d])	Asthma control status as the response variable Adjusted Prevalence Ratio aPR[e] (95% CI[e])	Uncontrolled asthma & taking LTC medication (n = 16 088) Unadjusted Percentage %[d] (95% CI[d])	Uncontrolled asthma & not taking LTC medication (n = 11 744) Unadjusted Percentage %[d] (95% CI[d])	LTC medication as the response variable Adjusted Prevalence Ratio aPR[f] (95% CI[f])
Health care coverage in past 12 months		$p = 0.0052$		$p = 0.0000$	$p = 0.0000$	
Yes	47 441 (86.9)	49.4 (48.3–50.5)	0.9 (0.86–0.98)	28.0 (27.1–28.9)	21.4 (20.6–22.3)	1.2 (1.1–1.3)
No	4616 (13.1)	54.7 (51.1–58.2)	Referent	19.1 (16.6–21.9)	35.5 (32.3–38.9)	Referent
Routine care visits (one or more)		$p = 0.0000$		$p = 0.0000$	$p = 0.0000$	
Yes	29 823 (55.2)	60.4 (59.1–61.7)	1.6 (1.5–1.7)	38.6 (37.4–39.9)	21.8 (20.7–22.9)	1.8 (1.7–1.9)
No	21 515 (44.8)	36.4 (34.8–38.0)	Referent	11.6 (10.7–12.7)	24.8 (23.3–26.2)	Referent
Smoking		$p = 0.0000$		$p = 0.0000$	$p = 0.0000$	
Current smoker	9510 (19.5)	64.8 (62.4–67.1)	1.3 (1.2–1.4)	26.5 (24.6–28.7)	38.2 (35.9–40.5)	0.8 (0.7–0.8)
Former smoker	17 622 (27.1)	53.4 (51.6–55.2)	1.1 (1.0–1.1)	32.2 (30.6–33.8)	21.2 (19.9–22.6)	1.0 (0.9–1.1)
Never smoked	24 858 (53.4)	43.0 (41.6–44.5)	Referent	24.0 (22.9–25.3)	19.0 (17.8–20.2)	Referent
BMI		$p = 0.0000$		$p = 0.0000$	$p = 0.0000$	
Obese	20 714 (39.4)	54.8 (53.1–56.5)	1.1 (1.0–1.1)	31.0 (29.5–32.5)	23.9 (22.5–25.2)	1.0 (1.0–1.1)
Non-obese	29 539 (60.6)	46.6 (45.3–48.0)	Referent	23.9 (22.9–25.0)	22.7 (21.6–23.9)	Referent
COPD[j]		$p = 0.0000$		$p = 0.0000$	$p = 0.0000$	
Yes	21 539 (34.6)	66.3 (64.8–67.8)	1.3 (1.3–1.4)	37.5 (36.0–39.0)	29.0 (27.5–30.4)	1.0 (1.0–1.1)
No	30 480 (65.4)	41.4 (40.1–42.8)	Referent	21.1 (20.1–222.2)	20.3 (19.2–21.4)	Referent
Depression		$p = 0.0000$		$p = 0.0000$	$p = 0.0000$	
Yes	19 734 (34.7)	58.9 (57.3–60.6)	1.1 (1.1–1.2)	31.2 (29.7–32.7)	27.8 (26.3–29.3)	1.0 (1.0–1.1)
No	32 133 (65.3)	45.4 (41.6–46.7)	Referent	24.5 (23.4–25.6)	20.9 (19.8–22.0)	Referent

CI, confidence interval; BMI, body mass index; COPD, chronic obstructive pulmonary disease.

[a] Defined as the most impaired level from the one or more individual elements (i.e., daytime and nighttime symptoms in past 30 days and rescue medication use in past 3 months).

[b] Persons who answered "yes" to the questions, "Have you ever been told by a doctor or other health professional that you had asthma?" and "Do you still have asthma?"

[c] Unweighted pooled sample size, 2006–2010. Individual characteristic categories might not sum to total because of item non-response.

[d] Weighted prevalence or 95% CI.

[e] Logistic regression model results (prevalence ratio) with uncontrolled asthma as the response variable.

[f] Logistic regression model results (prevalence ratio) with long-term asthma control medication use as the response variable among adults with uncontrolled asthma.

[g] $P<0.05$ for the chi-square test of association between asthma controlled status and selected variables.

[h] $P<0.05$ for the chi-square test of association between asthma controlled status, long-term asthma control medication use and selected variables.

[i] Race categories "white, non-Hispanic" and "black, non-Hispanic" include persons who indicated only a single race group. "Other races, non-Hispanic" includes Asian, American Indian Alaskan Native, Native Hawaiian and Other Pacific Islander, persons reporting more than one race, and persons reporting their race as something other than those listed here.

[j] Combined responses to questions for COPD, emphysema, and chronic bronchitis.