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# Age at asthma onset and subsequent asthma outcomes among adults with active asthma

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## Summary

**Introduction—**Little is known about the extent to which the age at which asthma first began influences respiratory health later in life. We conducted these analyses to examine the relationship between age at asthma onset and subsequent asthma-related outcomes.

**Methods—**We used data from 12,216 adults with asthma who participated in the 2010 Behavioral Risk Factor Surveillance System Asthma Call-back Survey to describe the distribution of age at asthma onset. Linear regression was used to estimate associations of age at asthma onset with asthma-related outcomes, including symptoms in the past 30 days and asthma-related emergency visits.

**Results—**Asthma onset before age 16 was reported by an estimated 42% of adults with active asthma, including 14% with onset at 5–9 years of age who reported experiencing any asthma symptoms on 21% of days in the past month. Compared to this group, the percentage of days in the past month with any asthma symptoms was 14.8% higher (95% confidence interval (CI): 5.4, 24.1) among those whose asthma onset occurred at <1 year. When age at onset occurred at 10 years or older there was little change in the prevalence of asthma-related emergency visits across age at onset categories.

**Conclusion—**Age at asthma onset may affect subsequent asthma-related outcomes.

### Keywords

Asthma; Epidemiology; Prevalence; Respiratory health; Surveillance

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**Conflicts of interest**

The authors declare no conflicts of interest.

## Introduction

Asthma affects a growing proportion of the population around the world [1]. In the United States, the estimated prevalence of asthma increased from 7.3% in 2001 to 8.4% in 2010, with higher prevalences reported among children aged 0–17 than among adults [2]. The coughing, wheezing, chest tightness, and difficulty breathing that are characteristic of asthma can begin at any age and may persist throughout life, [3–5] though little is known about the extent to which the age at which asthma first began is associated with the presence, frequency, or severity of subsequent respiratory health outcomes. If the age at asthma onset is associated with respiratory outcomes later in life, then improving our understanding of these associations may increase our ability to introduce educational, environmental, and clinical interventions at an age at which they may be most effective. Data from the Behavioral Risk Factor Surveillance System (BRFSS) Asthma Call-back Survey provide a unique opportunity to describe the distribution of age at asthma onset among adults with active asthma and examine associations between age at asthma onset and subsequent asthma-related outcomes among adults in the United States.

## Methods

### Asthma Call-back Survey

We conducted these analyses using data from the 2010 BRFSS Asthma Call-back Survey. BRFSS is an ongoing, state-based, random-digit-dialed telephone survey of noninstitutionalized men and women aged 18 years and older residing in the United States [6,7]. In 2010, the BRFSS survey sample was based on disproportionate stratified sampling of landline telephones from strata of high density and medium density of known household telephone numbers in 50 states, the District of Columbia, Guam, Puerto Rico, and the U.S. Virgin Islands [8]. Additional detailed information about the multistage sampling design and sample weighting used for BRFSS is available elsewhere [6,7,9]. The Asthma Call-back Survey is a follow-up telephone survey conducted approximately two weeks after BRFSS interviews among respondents in who indicated that they have ever had asthma by responding ‘yes’ to the following question: “have you ever been told by a doctor, nurse, or other health professional that you had asthma?” In 2010, the National Asthma Control Program provided funding to 37 states, the District of Columbia, and Puerto Rico to conduct the Asthma Call-back Survey. The 37 states are: Alabama, Arizona, California, Connecticut, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Vermont, Washington, West Virginia, and Wisconsin. In 2010, ever having a history of asthma was reported by 42,584 BRFSS respondents in the subset of 37 states, the District of Columbia, and Puerto Rico; of these BRFSS respondents, 17,753 responded to the Asthma Call-back Survey. The Council of American Survey and Research Organization [10] response rates among participating areas ranged from 34% to 64% (overall: 49%; median: 50%) [11]. The BRFSS Asthma Call-back Survey is exempt from Institutional Review Board (IRB) review at the Centers for Disease

Control and Prevention; state-specific IRB requirements apply to each of the participating states, the District of Columbia, and Puerto Rico.

### Study sample

For this analysis, we present results based on analysis of data from 12,216 respondents with active asthma (Fig. 1). As in previous analysis of Asthma Call-back Survey data [12], respondents were categorized as having active asthma if they reported that at least one of the following occurred during the past 12 months: talked to a doctor or other health professional about [his/her] asthma, took asthma medication, or experienced any symptoms of asthma. Our final group of selected respondents is limited to those who provided an age at asthma onset, current age, and time since asthma onset; whose responses regarding age at asthma onset, current age, and time since asthma onset were consistent; and for whom information about smoking status and race/ethnicity was not missing.

### Age at asthma onset

We used responses to the following questionnaire item, “how old were you when you were first told by a doctor or other health professional that you had asthma?” to indicate the ages at which respondents’ asthma began (hereafter referred to as “age at asthma onset”). We categorized the distribution of age, in years, at asthma onset: <1, 1–4, 5–9, 10–14, 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, and 75–92.

### Asthma-related outcomes

The frequency of current symptoms was evaluated using responses to two items: “during the past 30 days, on how many days did you have any symptoms of asthma?”; and “during the past 30 days, on how many days did symptoms of asthma make it difficult for you to stay asleep?”. For both outcomes, we calculated the percentage of days with each outcome during the time period by dividing the response by 30 days and multiplying by 100.

The degree to which respondents experienced exacerbations of their asthma was evaluated to indicate the severity of the asthma-related outcomes using responses to three questionnaire items: “during the past 12 months, have you had an episode of asthma or an asthma attack?”; “during the past 12 months, have you had to visit an emergency room or urgent care center because of your asthma?”; and “during the past 12 months, that is since [one year ago today], have you had to stay overnight in a hospital because of your asthma?”. For all outcomes, we considered uninformative responses (i.e., don’t know, missing, refused) to be negative responses.

### Other covariates

Demographic covariates shown include current age, race/ethnicity, and sex. Health-related covariates include cigarette smoking status, history of chronic obstructive pulmonary disease (COPD), history of angina or coronary heart disease, and time since asthma diagnosis. Cigarette smoking status was categorized as current smoker who smokes every day, current smoker who smokes some days, former smoker, and lifetime nonsmoker. Respondents who reported ever being told by a doctor or health professional that they had COPD, emphysema,

or chronic bronchitis were identified as having a history of COPD. Respondents who reported ever being told that they had angina or coronary heart disease were identified as having a history of angina or coronary heart disease. Respondents reported the time since being diagnosed with asthma as less than one year, one to five years, or more than five years.

### Statistical analysis

Demographic and health-related characteristics are presented for the sample of respondents and the weighted population estimate. In each age at onset category, asthma-related outcomes are presented as weighted, unadjusted percentages, with standard errors (SE). Associations between age at asthma onset and the asthma-related outcomes were estimated using linear regression and are presented as percent differences (PD), with 95% confidence intervals (CI). For each outcome, associations were estimated using a single model in which the prevalence of the asthma outcome was evaluated in each category of age at asthma onset, with the referent category of 5–9 years. The age category of 5–9 years was selected as a referent group because of the large size of the actual sample and estimated population in this category. PDs are interpreted as the absolute difference between the percentages of the outcome in a given category of age at onset and in the referent category. All models included 16 indicator variables for the categories of age at asthma onset, accounted for the survey sampling methods, and were adjusted for age as a continuous variable, race/ethnicity, sex, smoking status, time since asthma onset, history of COPD, and history of angina or coronary heart disease.

For weighted population estimates, we used sampling weights provided with the Asthma Call-back Survey data to account for BRFSS and Asthma Call-back Survey nonresponse and unequal sampling probabilities. We conducted the analyses using procedures for analysis of complex sample survey data in SAS version 9.3 (SAS Institute Inc., Cary, North Carolina, USA) and used the Taylor series method [10,11] to estimate variance under the sampling conditions (i.e., sampling with replacement) used in the BRFSS Asthma Call-back Survey [13]. To properly account for the complex sample survey design [14], we retained the entire sample ($n$ = 17,753) in our final analyses and present only the results generated from the stratum consisting of our selected population of 12,216 respondents.

Following our final analysis, we conducted separate analyses to evaluate the sensitivity of our results to two decisions made in creating our final study sample: categorizing 754 individuals with uninformative (i.e., don’t know, missing, and refused) responses to the asthma outcome questionnaire items as not having the relevant outcomes and including 1682 respondents whose asthma onset occurred within the last five years.

## Results

Table 1 presents the demographic and health-related characteristics of the 12,216 adults with active asthma in our final study sample and the estimated 17.6 million adults represented by the survey sample. The sample included adult men and women aged 18–99 years. An estimated 42% of adults with active asthma reported the onset of asthma as occurring before the age of 16; in this group, asthma onset occurred at a mean age of 7 years (SE: 0.2). In the

remaining group with onset at age 16 or older, asthma onset occurred at a mean age of 38 years (SE: 0.3). An estimated 87% of adults with active asthma reported that the onset of asthma occurred more than five years ago.

The distribution of age at asthma onset in the actual sample and estimated populations and adjusted PDs generated for the two metrics of the frequency of asthma symptoms are shown in Table 2; mean reported frequencies of the two outcomes for the entire estimated population and across categories of age at asthma onset are shown in Fig. 2. Overall, low mean percentages of the past 30 days with any symptoms of asthma (mean: 21%; SE: 1.9) and with asthma symptoms that made it difficult to stay asleep (mean: 8%; SE: 1.4) were observed among respondents who reported asthma onset at age 5–9 years. Relative to this referent group, the adjusted estimate of the percentage of the past 30 days with any symptoms of asthma was 14.8% higher (95% CI: 5.4, 24.1) and the adjusted estimate of the percentage of the past 30 days with symptoms that made it difficult to stay asleep was 8.1% higher (95% CI: 1.1, 15.0) among those who reported the onset as occurring before 1 year of age.

Table 3 show estimated percentages of adults with active asthma reporting an episode or attack of asthma in the past 12 months, an emergency department or urgent care center visit for asthma in the past 12 months, and an overnight hospital stay in the past 12 months because of asthma. The prevalence of each of the three outcomes declined notably across the three categories of increasing age at asthma onset before 10 years of age (Fig. 2). However, when asthma onset occurred at 10 years or older, there was little change in the prevalence of emergency or urgent care visits or overnight hospital stays across categories of age at onset. Adjusted estimates of the association between age at asthma onset and experiencing episodes or attacks of asthma during the past 12 months were lowest among adults whose asthma onset occurred at age 50 or older, compared to those whose onset occurred at 5–9 years (Table 3).

We conducted a secondary set of analyses that excluded respondents with uninformative responses (i.e., don’t know, missing, refused) to asthma outcome questions. In our final study sample, these 754 respondents represent 4.2% (95% CI: 3.3, 5.1) of the estimated population. The percentage of the estimated population with uninformative responses to specific asthma outcome questionnaire items ranged from 0.2% (95% CI: 0.1, 0.4) for responses about emergency room or urgent care center visits to 1.9% (95% CI: 1.4, 2.4) for responses about asthma symptoms that made it difficult to stay asleep. In analyses that excluded these respondents, results were similar to those presented in Tables 2 and 3. Restricting our analyses to respondents whose asthma onset occurred five or more years ago generated adjusted estimates similar to those generated in our main analyses (data not shown).

## Discussion

Our findings indicate that among adults with active asthma, the age at which asthma began may be associated with subsequent exacerbations of asthma. Most notably, among adults who self-reported asthma onset as occurring before 15 years of age, the highest percentage

of the past 30 days with symptoms and the highest percentage of respondents with emergency or urgent care visits occurred among those whose asthma onset occurred at less than 1 year. For several of the outcomes we evaluated, little variation in the magnitude of the outcomes was observed across categories of adult-onset asthma until age at onset reached late adulthood. Among those whose onset occurred at older ages, the observed increases in the percentage of respondents who reported experiencing an episode or attack of asthma, emergency or urgent care visits, or hospitalizations for asthma in the past 12 months may reflect more severe asthma in older adults, a lower level of control among recently diagnosed individuals, the presence of co-morbidities resulting in emergency visits attributed to asthma, or a combination of conditions or circumstances that lead to increased severity of asthma among older adults. Our estimates of the prevalence of asthma outcomes among adults whose asthma onset occurred at older ages should therefore be interpreted with caution.

Metrics of the severity of asthma, asthma control, and COPD have each been associated with health-related quality of life [15–17] and asthma has been associated with accelerated lung function decline over time. [18–20] Recent epidemiologic evidence that decreased lung function may be a predictor of cardiovascular morbidity and mortality [21–26] suggests that changes in the prevalence of asthma may have large impacts on the health of aging populations. We found that the frequency and severity of respiratory outcomes may be associated with the age at which asthma onset occurs and that the lowest occurrences of these outcomes are generally observed among individuals whose asthma onset occurred at ages 5–9 years. These findings support evidence that among children with wheezing symptoms, the timing of onset may be associated with subsequent asthma outcomes [27], and extend these findings by assessing asthma-related outcomes in later life and across a wide range of ages at onset. Our findings reveal opportunities for further investigation of the role of age at asthma onset in determining behaviors, such as using medication, recognizing and avoiding symptom triggers, or communicating with health care personnel, which may influence respiratory health outcomes. If children who were first told that they had asthma when they were 5–9 years old developed better asthma self-management skills than children who whose onset occurred during infancy and whose asthma was managed to a greater extent by their parents, then our findings reveal important opportunities to examine educational approaches to asthma management. Similarly, our findings suggest that if respiratory infections during early life or other factors associated with the onset of asthma are also associated with the age at asthma onset, then such factors may also be associated with asthma-related outcomes in later life. However, our ability to draw conclusions about the etiology of early asthma onset or the relationship between etiologic risk factors and asthma outcomes in later life is limited by our use of cross-sectional surveillance data.

Our findings should be interpreted carefully. The 2010 Asthma Call-back Survey represents adults in 37 U.S. states, the District of Columbia, and Puerto Rico and these data should not be considered nationally representative. In addition, 2010 Asthma Call-back Survey respondents self-reported their asthma status, onset, and current respiratory-related outcomes in interviewer-administered landline telephone surveys and we were unable to verify or validate the information provided. Analysis of the extent to which self-reported asthma and age at asthma onset may be affected by differential recall has indicated that while reports of

age at asthma onset are generally accurate, self-reported asthma status may vary by asthma severity – that is, individuals with mild asthma may be less likely to report their asthma during a follow-up interview [28]. If the 2010 Asthma Call-back Survey data were affected by such a bias in the reporting of asthma status, then adults with mild asthma may be under-represented in our sample. The accuracy with which adults self-report age at asthma onset, particularly when onset occurred during infancy or early childhood, is also unknown. Evaluation of the relationship between asthma severity and self-reported age at asthma onset in data sources that include documentation of onset would improve our understanding of the relationship between age at asthma onset and subsequent asthma outcomes. Likewise, if adults with a history of smoking, symptoms of COPD, or other conditions that affect their breathing incorrectly attributed their outcomes to asthma, then asthma-related exacerbations may be over-reported in the Asthma Call-back Survey.

Our final models are adjusted for smoking status and history of COPD, angina, or coronary heart disease, however, our results, particularly those generated for older age at onset categories, should be interpreted with caution. If older adults with COPD are systematically misdiagnosed with new-onset asthma or self-report the onset of asthma, then our results do not accurately represent the respiratory health status of older adults with asthma. Cautious interpretation is also warranted because of the collinearity between current age, age at asthma onset, and time since onset. The sensitivity analyses in which we restricted our final study sample to respondents who reported that asthma onset occurred five or more years ago differentially excluded older respondents and those whose asthma occurred at older ages, but did not affect the interpretation of our results. Our results are based on linear regression models, which are typically robust to violations of assumptions about the variance of the response. Nonetheless, our assessment of the data for its compatibility with linear regression methods indicated that older age categories may be affected by outliers or non-normally distributed residuals that limit further justify caution in interpreting the results generated for older age at onset categories. However, such violations must be extreme to generate large biases [29] and without further justification for restricting our analysis to younger adults, we have opted to present findings across the entire range of age groups represented by these data. In addition, restricting our analyses to 11,846 respondents with valid metrics of body mass index and adjusting our final models for body mass index did not suggest confounding of the relationship between age at asthma onset and the asthma-related outcomes by body mass index (data not shown).

Our description of asthma-related outcomes by age at asthma onset and our findings of variation in asthma-related symptoms and unexpected health care visits due to asthma across categories of age at onset, particularly across younger age categories, are novel. Age at asthma onset is often reported as occurring before or after a relevant age [30–32]. Our descriptive presentation of age at asthma onset suggests that when the burden of asthma-related outcomes is of interest, differences in age at onset should be considered carefully. The degree to which variations in the asthma-related outcomes evaluated here are due to biological or behavioral factors remains unclear. If the age at asthma onset affects the manner in which a patient learns how to manage and treat symptoms of asthma, then our findings reveal opportunities to examine how this knowledge may be used to improve asthma management and subsequent respiratory health outcomes.

## Acknowledgments

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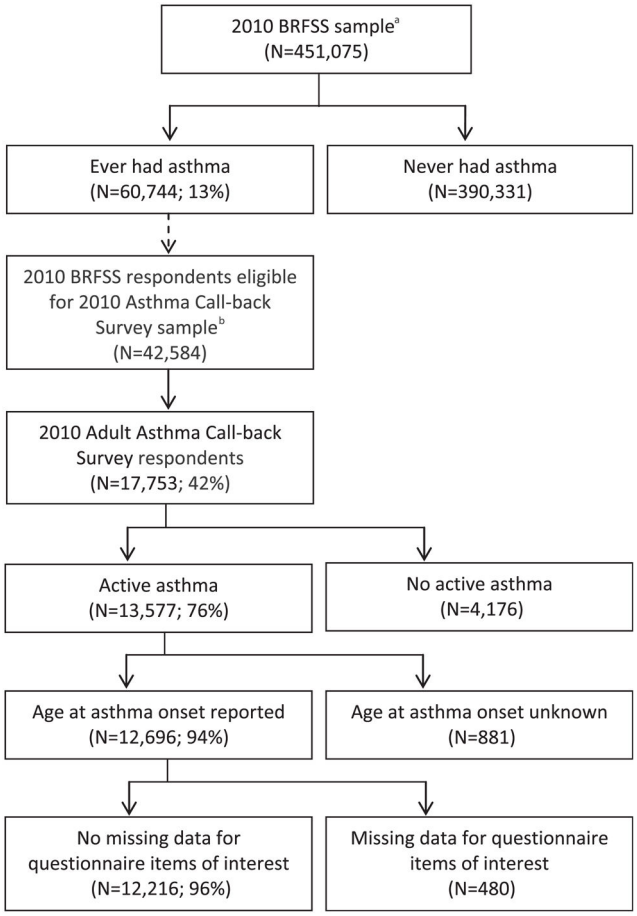


**Figure 1.**

Selection of the study sample: 2010 BRFSS Adult Asthma Call-back Survey. [a]The 2010 BRFSS was conducted in 50 states, the District of Columbia, Guam, Puerto Rico, and the U.S. Virgin Islands. [b]The 2010 Adult Asthma Call-back Survey was conducted in 37 states, the District of Columbia, and Puerto Rico. In 2010, 42,584 BRFSS respondents in the 37 states, the District of Columbia, and Puerto Rico reported ever having asthma. A dashed line is used to indicate that Asthma Call-back Survey respondents are not representative the 60,744 BRFSS respondents with asthma and therefore a percentage is not shown.

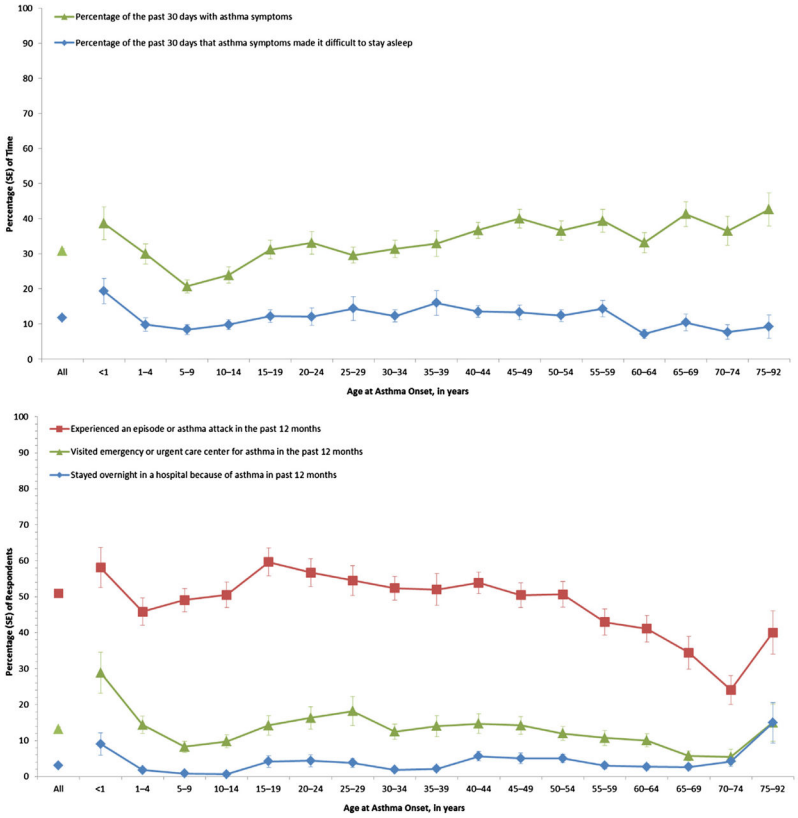


**Figure 2.**

Percentage of days in the past 30 that respondents reported experiencing any asthma symptoms or difficulty staying asleep because of asthma symptoms (above). Percentage of respondents who reported an episode or attack of asthma in the past 12 months, an emergency department or urgent care center visit for asthma in the past 12 months, and an overnight hospital stay in the past 12 months because of asthma (below).

## Table 1

Demographic and health-related characteristics of the study sample: 2010 BRFSS Adult Asthma Call-back Survey.

| | Actual sample[a] | Weighted population estimate | |
|---|---|---|---|
| | No. | No. | Percent (95% CI) |
| Total | 12,216 | 17,552,107 | – |
| **Demographic characteristics** | | | |
| Race/ethnicity | | | |
| White, non-Hispanic | 9724 | 12,900,295 | 73.5 (71.6, 75.4) |
| Black, non-Hispanic | 973 | 1,685,590 | 9.6 (8.3, 10.9) |
| Other, non-Hispanic | 818 | 1,066,762 | 6.1 (5.2, 7.0) |
| Hispanic | 701 | 1,899,460 | 10.8 (9.3, 12.4) |
| Sex | | | |
| Male | 3226 | 6,445,183 | 36.7 (34.6, 38.8) |
| Female | 8990 | 11,106,924 | 63.3 (61.2, 65.4) |
| **Health-related characteristics** | | | |
| Age at asthma onset, in years | | | |
| <16 | 3456 | 7,402,854 | 42.2 (40.0, 44.3) |
| ≥16 | 8760 | 10,149,253 | 57.8 (55.7, 60.0) |
| History of COPD | | | |
| No | 7100 | 11,661,818 | 66.4 (64.6, 68.3) |
| Yes | 5116 | 5,890,289 | 33.6 (31.7, 35.4) |
| History of angina or coronary heart disease | | | |
| No | 10,926 | 16,367,525 | 93.3 (92.4, 94.1) |
| Yes | 1290 | 1,184,582 | 6.7 (5.9, 7.6) |
| Smoking status | | | |
| Current smoker, smokes every day | 1455 | 2,269,536 | 12.9 (11.6, 14.3) |
| Current smoker, smokes some days | 626 | 838,642 | 4.8 (4.0, 5.6) |
| Former smoker | 4202 | 4,787,711 | 27.3 (25.6, 28.9) |
| Lifetime non-smoker | 5933 | 9,656,219 | 55.0 (53.0, 57.0) |
| Time since asthma onset | | | |
| <1 Year | 389 | 555,899 | 3.2 (2.4, 4.0) |
| 1–5 Years | 1293 | 1,774,826 | 10.1 (9.0, 11.3) |
| >5 Years | 10,534 | 15,221,383 | 86.7 (85.4, 88.1) |

[a]Unweighted sample.

**Table 2**

Associations between age at asthma onset and the percentage of days in the past 30 that respondents reported experiencing any asthma symptoms or difficulty staying asleep because of asthma symptoms: 2010 BRFSS Adult Asthma Call-back Survey.

| Age at asthma onset, in years | Actual sample[a] | Weighted population estimate | | Percentage of the past 30 days with any asthma symptoms | | Percentage of the past 30 days that asthma symptoms made it difficult to stay asleep | |
|---|---|---|---|---|---|---|---|
| | No. | No. | Percent (95% CI) | Mean (SE)[b] | PD (95% CI)[c] | Mean (SE) | PD (95% CI) |
| <1 | 386 | 711,587 | 4.1 (3.2, 4.9) | 38.7 (4.7) | 14.8 (5.4, 24.1) | 19.4 (3.6) | 8.1 (1.1, 15.0) |
| 1–4 | 667 | 1,430,279 | 8.1 (6.9, 9.4) | 30.0 (2.8) | 7.1 (0.4, 13.8) | 9.8 (1.9) | 0.4 (−4.3, 5.1) |
| 5–9[d] | 1189 | 2,420,910 | 13.8 (12.2, 15.4) | 20.7 (1.9) | 0.0 | 8.4 (1.4) | 0.0 |
| 10–14 | 1031 | 2,488,065 | 14.2 (12.4, 15.9) | 24.0 (2.3) | 2.6 (−3.4, 8.5) | 9.8 (1.4) | 0.9 (−3.2, 4.9) |
| 15–19 | 714 | 1,273,925 | 7.3 (6.1, 8.4) | 31.2 (2.6) | 7.8 (1.7, 14.0) | 12.2 (1.8) | 2.3 (−2.0, 6.6) |
| 20–24 | 737 | 1,123,835 | 6.4 (5.4, 7.4) | 33.1 (3.2) | 9.2 (2.0, 16.4) | 12.1 (2.5) | 2.7 (−2.5, 8.0) |
| 25–29 | 756 | 1,127,007 | 6.4 (5.4, 7.5) | 29.6 (2.3) | 4.9 (−1.0, 10.7) | 14.4 (3.4) | 5.3 (−0.9, 11.5) |
| 30–34 | 879 | 1,303,050 | 7.4 (6.5, 8.4) | 31.4 (2.5) | 6.2 (−0.4, 12.7) | 12.3 (1.7) | 2.4 (−2.3, 7.2) |
| 35–39 | 855 | 1,167,378 | 6.7 (5.6, 7.8) | 32.9 (3.7) | 7.0 (−0.3, 14.4) | 16.0 (3.5) | 5.6 (−0.5, 11.8) |
| 40–44 | 1074 | 1,237,980 | 7.1 (6.2, 7.9) | 36.7 (2.3) | 11.0 (5.0, 17.1) | 13.6 (1.7) | 4.6 (0.3, 8.8) |
| 45–49 | 832 | 852,792 | 4.9 (4.2, 5.5) | 40.1 (2.7) | 13.3 (6.3, 20.3) | 13.3 (2.0) | 4.1 (−0.9, 9.1) |
| 50–54 | 987 | 866,012 | 4.9 (4.3, 5.6) | 36.6 (2.8) | 8.9 (2.2, 15.7) | 12.4 (1.7) | 2.8 (−1.6, 7.1) |
| 55–59 | 672 | 503,069 | 2.9 (2.4, 3.3) | 39.4 (3.2) | 10.1 (2.0, 18.2) | 14.4 (2.4) | 4.2 (−1.2, 9.6) |
| 60–64 | 591 | 418,508 | 2.4 (2.0, 2.7) | 33.2 (2.9) | 4.1 (−3.5, 11.7) | 7.1 (1.2) | −2.1 (−6.5, 2.3) |
| 65–69 | 355 | 242,025 | 1.4 (1.1, 1.7) | 41.3 (3.6) | 12.5 (2.9, 22.1) | 10.4 (2.4) | 2.4 (−4.3, 9.1) |
| 70–74 | 263 | 198,606 | 1.1 (0.9, 1.4) | 36.6 (4.1) | 8.4 (−2.5, 19.3) | 7.7 (2.1) | 0.6 (−5.5, 6.7) |
| 75–92 | 228 | 187,079 | 1.1 (0.8, 1.3) | 42.7 (4.8) | 14.3 (2.2, 26.4) | 9.2 (3.3) | 3.3 (−4.7, 11.4) |

[a] Unweighted sample.

[b] Mean percentage, with standard error (SE).

[c] Percent difference (PD), adjusted for age, race/ethnicity, sex, smoking status, time since asthma onset, history of COPD, and history of angina or coronary heart disease.

[d] Referent category.

**Table 3**

Associations between age at asthma onset and the prevalence of asthma-related outcomes: 2010 BRFSS Adult Asthma Call-back Survey.

| Age at asthma onset, in years | Experienced an episode or asthma attack in the past 12 months | | Visited emergency or urgent care center for asthma in the past 12 months | | Stayed overnight in a hospital because of asthma in the past 12 months | |
|---|---|---|---|---|---|---|
| | Percent (SE)[a] | PD (95% CI)[b] | Percent (SE) | PD (95% CI) | Percent (SE) | PD (95% CI) |
| <1 | 58.1 (5.5) | 6.1 (−6.3, 18.5) | 28.9 (5.7) | 17.8 (6.8, 28.9) | 9.1 (3.1) | 7.2 (1.3, 13.1) |
| 1–4 | 45.8 (3.8) | −4.2 (−14.7, 6.3) | 14.4 (2.4) | 5.8 (−1.8, 13.3) | 1.8 (0.8) | 0.6 (−0.9, 2.1) |
| 5–9[c] | 49.0 (3.3) | 0.0 | 8.3 (1.6) | 0.0 | 0.8 (0.2) | 0.0 |
| 10–14 | 50.5 (3.5) | 0.2 (−8.9, 9.4) | 9.8 (1.8) | 1.1 (−3.6, 5.7) | 0.7 (0.3) | 0.0 (−0.8, 0.8) |
| 15–19 | 59.6 (3.9) | 5.6 (−4.2, 15.3) | 14.2 (2.7) | 3.0 (−3.0, 9.0) | 4.2 (1.7) | 2.4 (−0.8, 5.6) |
| 20–24 | 56.7 (3.9) | 3.9 (−5.8, 13.6) | 16.3 (3.1) | 5.4 (−1.1, 11.9) | 4.4 (1.7) | 2.2 (−1.0, 5.5) |
| 25–29 | 54.5 (4.2) | 0.6 (−8.6, 9.9) | 18.2 (4.1) | 7.4 (−0.6, 15.4) | 3.8 (1.3) | 1.4 (−1.3, 4.1) |
| 30–34 | 52.4 (3.3) | 0.6 (−8.5, 9.8) | 12.5 (2.1) | 2.1 (−3.3, 7.4) | 1.9 (0.7) | −0.6 (−2.2, 1.1) |
| 35–39 | 52.0 (4.4) | −0.8 (−10.8, 9.3) | 14.0 (2.9) | 2.1 (−4.2, 8.3) | 2.1 (0.6) | −1.1 (−2.6, 0.5) |
| 40–44 | 53.9 (3.0) | 1.0 (−7.8, 9.7) | 14.7 (2.7) | 3.2 (−2.9, 9.4) | 5.7 (1.3) | 2.1 (−0.5, 4.6) |
| 45–49 | 50.4 (3.4) | −2.9 (−12.0, 6.1) | 14.2 (2.5) | 2.7 (−3.2, 8.6) | 5.1 (1.5) | 1.3 (−1.6, 4.3) |
| 50–54 | 50.6 (3.5) | −2.4 (−11.5, 6.7) | 12.0 (1.9) | 0.1 (−4.9, 5.1) | 5.0 (1.2) | 0.8 (−2.0, 3.7) |
| 55–59 | 42.9 (3.6) | −11.1 (−21.2, −0.9) | 10.7 (2.1) | −1.3 (−7.0, 4.4) | 3.0 (0.9) | −2.0 (−4.6, 0.7) |
| 60–64 | 41.1 (3.7) | −10.7 (−21.3, −0.1) | 10.1 (1.8) | −1.3 (−7.0, 4.4) | 2.7 (0.9) | −2.4 (−5.0, 0.3) |
| 65–69 | 34.4 (4.5) | −16.0 (−28.1, −4.0) | 5.7 (1.4) | −5.1 (−10.7, 0.5) | 2.7 (0.9) | −2.4 (−5.3, 0.4) |
| 70–74 | 24.1 (4.0) | −25.2 (−36.6, −13.8) | 5.4 (2.2) | −5.2 (−12.0, 1.6) | 4.2 (1.5) | −1.0 (−4.7, 2.6) |
| 75–92 | 40.0 (6.0) | −12.6 (−27.6, 2.3) | 15.0 (5.2) | 2.2 (−8.7, 13.1) | 14.9 (5.6) | 8.5 (−2.2, 19.2) |

[a] Percent, with standard error (SE).

[b] Percent difference (PD), adjusted for age, race/ethnicity, sex, smoking status, time since asthma onset, history of COPD, and history of angina or coronary heart disease.

[c] Referent category.