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PHENOTYPES

Agreement between current and active asthma classification methods, Asthma Call-back Survey, 2011–2012

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Abstract

Objective: Various approaches have been developed to identify persons with asthma using survey data. To assess agreement between current and active asthma classifications, 2011–2012 Asthma Call-back Survey landline telephone household data from 38 states, District of Columbia, and Puerto Rico for adults aged ≥18 years who have ever been told by a health professional they have asthma were analyzed. *Methods*: Respondents were classified to have current asthma if they reported still having asthma, and active asthma if they reported within the past year: 1) talking to a doctor about asthma, 2) taking asthma medication, or 3) having any symptoms of asthma. Agreement between classifications was assessed using the Kappa statistic. *Results*: Among adults ever told by a health professional they have asthma, an estimated 72% had current asthma and 75% had active asthma. Overall, 67% of individuals met classifications of both current and active asthma and 20% had neither current nor active asthma (Kappa = 0.68). The Kappa increased to 0.72 when talking to a doctor about asthma was removed from the active asthma classification. *Conclusions*: Results indicated substantial agreement between current and active asthma. Agreement was strengthened when talking to a doctor about asthma was removed from the active asthma classification.

Keywords

Current asthma, active asthma, classification, agreement, BRFSS, ACBS

History

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Introduction

Asthma is a chronic disorder of the airways characterized by inflammation and narrowing of the airways [1]. The disease affected 18.7 million adults in the United States in 2010, placing a substantial burden on society [2]. An estimated $18 billion in medical expenditures is attributed annually to adult asthma [3].

Evaluating the population with asthma is necessary to enact effective preventive measures and health policies to attenuate this burden, and various criteria have been developed by researchers to ascertain cases [4–17]. However, there is no uniform approach in identifying survey respondents with asthma, and the use of the differing classification criteria may have a substantial effect on prevalence estimates [18]. Furthermore, although different classifications may result in similar prevalence estimates, they may not be capturing the same population [19]. This may lead to study results that are biased and ultimately not comparable with results from other studies [18,20].

U.S. national surveys, such as the Behavioral Risk Factor Surveillance System (BRFSS) and the National Health Interview Survey, collect information on asthma to determine the prevalence and burden of the disease in specific populations and to guide public health efforts on alleviating the impact of asthma [21–23]. Using these survey data, two classifications of asthma status, current asthma and active asthma, were developed [4–16]. For example, persons with current asthma were survey respondents who have ever been told by a health professional they have asthma and still have asthma. Based on National Health Interview Survey data, the current asthma classification has been used to assess trends in asthma prevalence and progress towards the Healthy People 2020 respiratory diseases objectives for asthma [24–26]. Likewise, based on the BRFSS Asthma Call-back Survey, researchers estimated the percentage of asthma associated with work among persons with current asthma [14], and the Council of State and Territorial Epidemiologists developed an occupational health indicator to measure the weighted frequency and percentage of ever-employed adults with current asthma who report that their asthma was caused or made worse by exposures at work [24].

Alternatively, to assess the asthma health outcomes, healthcare access and use, and sociodemographic characteristics of children and adults who received asthma management education, Zahran et al. defined their study population, using BRFSS Asthma Call-back Survey data, as those with active asthma [6]. Persons with active asthma were those who have ever been told by a health professional they have asthma and, within the past year, either have talked to a doctor about their asthma, or taken asthma medication, or had any symptoms of asthma. The

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active asthma classification has also been used to assess factors associated with asthma control, physician-diagnosed chronic obstructive pulmonary disease, and asthma outcomes associated with age at asthma onset [4,5,7].

The BRFSS Asthma Call-back Survey is a source often used by states and public health officials to assess the burden of asthma and prioritize public health action; however, two potential asthma classifications are available. The active asthma classification may identify a population that differs from that identified using the current asthma classification, making the results of asthma studies using these differing classifications incomparable and difficult to interpret for potential intervention. The objectives of this study were to assess the agreement between the two asthma case classifications, current and active asthma, available in the BRFSS Asthma Call-back Survey, and to assess the differences between populations identified using the active and current asthma classifications based on the 2011–2012 BRFSS Asthma Call-back Survey data.

Methods

The BRFSS, is an ongoing telephone survey of the non-institutionalized U.S. civilian population aged ≥18 years [27]. The survey is designed to collect information on preventive health practices and risk behaviors and includes a standardized core questionnaire, optional modules, and state-added questions. The adult Asthma Call-back Survey, an optional module, collects additional information on asthma during a follow-up interview two weeks after the initial BRFSS interview among participants who have ever been told by a health professional they have asthma [28].

The adult Asthma Call-back Survey was administered in 38 states, District of Columbia, and Puerto Rico in 2011 and in 36 states and District of Columbia in 2012 using the landline telephone household sample. The median American Association of Public Opinion Research response rate was 52.3% for BRFSS and 48.4% for the Asthma Call-back Survey in 2011; and 47.5% for BRFSS and 47.2% for the Asthma Call-back Survey in 2012 [29]. Recent methodology changes make the BRFSS Asthma Call-back Survey data collected prior to 2011 no longer comparable to those collected in 2011–2012 [30]. The Centers for Disease Control and Prevention Institutional Review Board has granted a surveillance exemption for BRFSS, but individual states participating in BRFSS are subject to the Institutional Review Board requirements of their own state.

For the current study, we followed current and active asthma definitions used in previous studies [4–16]. All Asthma Call-back Survey participants were first asked "Has a doctor, nurse, or other health professional ever told you that you had asthma?" If the answer was "no", the survey was terminated, if "yes", additional questions about their asthma were asked. An affirmative response to the subsequent question, "Do you still have asthma?" was used to identify persons with current asthma (Figure 1).

The following questions were used to identify persons with active asthma among those who were ever told by a health professional they had asthma: 1) "How long has it been since you last talked to a doctor or other health professional about your asthma?", 2) "How long has it been since you last took asthma medication?", or 3) "How long has it been since you last had any symptoms of asthma?" (Figure 1). Furthermore, we examined results of an additional six modified active asthma classifications (i.e., using responses to only one of the above three questions or a combination of responses to any two of the three questions).

To describe persons with current and active asthma, we used previously established definitions for asthma-related characteristics including work-relatedness, adverse asthma outcomes, financial barriers to asthma care, asthma control, activity limitations, and co-morbid conditions [8,9,11,31].

Analyses were done using SAS® version 9.3 (SAS Institute Inc., Cary, NC) and SUDAAN Release 11.0.1 (Research Triangle Institute, Research Triangle Park, NC). Landline household data from 2011–2012 were combined to ensure sufficient sample size for analyses. Data were weighted to account for survey non-response and unequal probability of sample selection. Weights for analyses were adjusted by multiplying the percentage of subjects in each state and survey year by the corresponding survey year's weight. For two states (Maryland and Utah) and Puerto Rico, only one year of data were available, and the weights were unaltered. Estimates were not reported if the relative standard error for the estimate was >30% or if the estimate was based on a sample of <50 respondents [27].

Agreement between current and active asthma classifications was assessed by calculating the observed agreement and the Kappa statistic (range: from 1 indicating perfect agreement to 0 indicating agreement equivalent to chance) [32]. We also calculated the percent difference between the percentages of those with current asthma and active asthma among those who were ever diagnosed with asthma, and assessed if the difference in percentages significantly differed from zero using a one-sided *t*-test. In addition, we assessed differences in percentages and agreement between current asthma and each of the six modified active asthma classifications.

We examined select demographic and clinical characteristics of those with current asthma and active asthma. However, because the work-related asthma (WRA) section of the Asthma Call-back Survey was revised in 2012, we restricted analyses to data from 2012 only to assess percentages of adults with WRA and possible WRA. Differences in estimates were considered statistically significant if the 95% confidence intervals (CIs) for the estimates did not overlap [28].

Results

An unweighted total of 29 142 adults aged ≥18 years participated in the landline household adult Asthma Call-back Survey in 38 states, District of Columbia, and Puerto Rico during 2011–2012 and provided information for this study. Respondents with missing/unknown information on current ($n = 562$) or active ($n = 9$) asthma were excluded from analyses. Among an estimated 28 million adults ever told by a health professional they had asthma, 72% had current asthma and 75% had active asthma. Overall, 67% of individuals met classifications of both current and active asthma, 20% had neither current nor active asthma, 5% had current asthma but no active asthma, and 8% had active asthma but no current asthma.

The observed agreement between current and active asthma classified using responses to all three questions was 87.4%

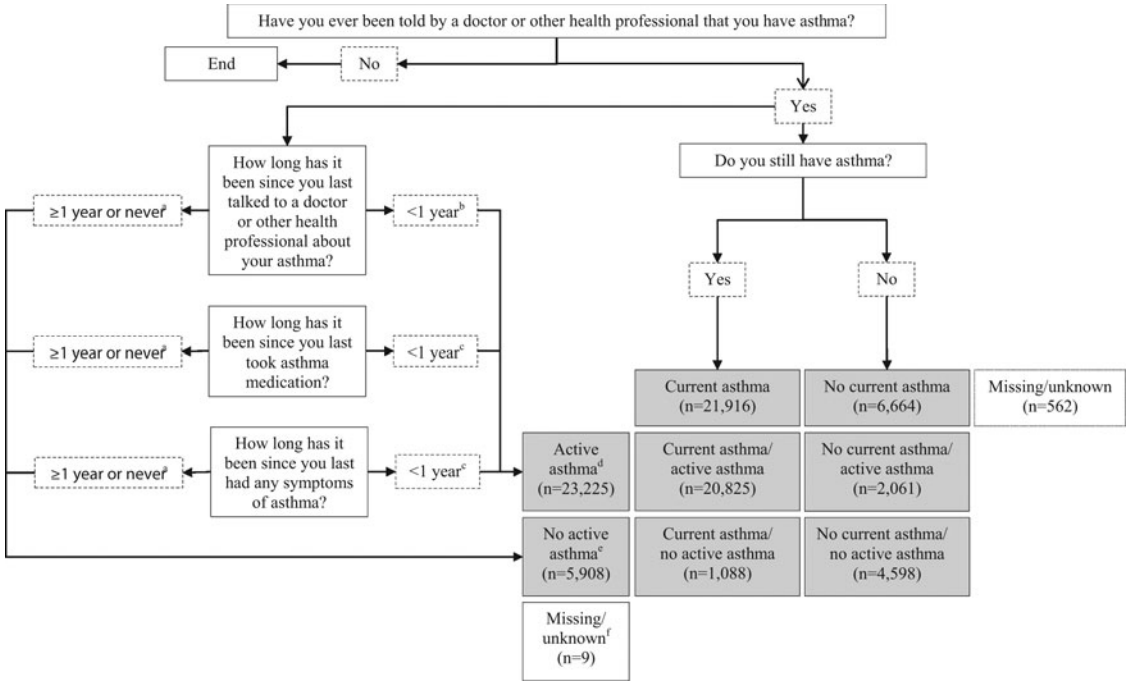

Figure 1. Determination of current and active asthma classifications and un-weighted sample sizes, BRFSS Asthma Call-back Survey, 2011–2012.
[a]Responded "1 year to less than 3 years ago," "3 years to 5 years ago," "more than 5 years ago," or "never."
[b]Responded "within the past year."
[c]Responded "less than one day ago", "1–6 days ago," "1 week to less than 3 months ago," or "3 months to less than 1 year ago."
[d]Responses consistent with footnotes b or c for any of the three active asthma questions.
[e]Responses consistent with footnote a for all three active asthma questions.
[f]Respondents who indicated "Missing/unknown" for all three active asthma questions were considered to have missing/unknown active asthma status.

(Kappa = 0.68, 95% CI: 0.64, 0.71) (Table 1). When modified active asthma classifications were examined, the observed agreement with current asthma was greatest when "having talked to a doctor about asthma within the last year" criterion was omitted from the active asthma classification (observed agreement = 88.7%; Kappa = 0.72, 95% CI: 0.70, 0.75). Furthermore, those with active asthma identified using only the criterion, talking to a doctor about asthma within the last year, had the lowest agreement with current asthma (observed agreement = 73.2%, Kappa = 0.44, 95% CI: 0.41, 0.47). Other modified active asthma classifications had similar agreement with current asthma as the active asthma classification based on responses to all three questions (Table 1). Similar results were found when the percent difference between the percentage of those with current asthma and active asthma was assessed.

An estimated 2.3 million ($n = 2061$) individuals had active asthma but no current asthma. Of these, 32.7% had only talked to a doctor, 25.6% only had asthma symptoms, and 20.1% met all three criteria for active asthma (Table 2).

Characteristics of persons identified as having current and active asthma are shown in Table 3. Although more survey participants were identified as having active asthma than current asthma, examined characteristics were similar between the two groups, as indicated by the overlapping 95% confidence intervals.

Discussion

This study demonstrated that, among persons who were ever told by a health professional they had asthma, using three questions to classify active asthma identified an estimated 4.6% larger population than using one question to classify current asthma. The current asthma and active asthma classifications agreed substantially and captured populations with similar demographic and clinical characteristics. Despite the substantial agreement, 13% were not consistently classified using either asthma classification criteria.

Talking to a doctor about asthma in the last year alone had the lowest agreement with current asthma. When this criterion was removed from the active asthma classification, the observed agreement with current asthma increased. In addition, the estimated percentage of persons with active asthma did not significantly differ from the percentage of persons with current asthma. This finding suggests that, while having talked with a physician in the last year is an important indication of asthma-related patient-physician communication, it may not be helpful in studies seeking to assess the diseased population, as these individuals may not truly have asthma or may have quiescent asthma and are not at risk for adverse asthma outcomes.

The self-reported physician-diagnosed asthma question has been previously validated against clinical asthma diagnosis (sensitivity = 68%, specificity = 94.3%) and objective pulmonary testing, such as bronchial hyperreactivity or a methacholine challenge test (sensitivity = 38%, specificity = 99%) [33–35]. The questions asking about still having asthma, talking to a doctor about asthma, and taking asthma medication, have not been validated; however, in previous studies, symptoms-based items, similar to the active asthma criterion, having any asthma symptoms in the last year, had high sensitivity (80%) and specificity (97%) [35]. A report by Pearce et al. suggests that symptoms-based questionnaires may

Table 1. Percentage of persons with active asthma and agreement between current and active asthma among adults who were ever diagnosed with asthma, by active asthma classification.

Asthma classification criterion	Sample N[a]	Estimated N[b]	Proportion of those who were ever diagnosed with asthma (%)	Percent change from proportion of current asthma[c] (%)	T test *p*-value	Observed agreement (%)	Kappa	95% CI
Talked to doctor[d]	17 707	15 135 063	54.2	− 24.3	<0.0001	73.2	0.44	0.41, 0.47
Taken asthma medication[e]	19 497	17 119 446	61.2	− 14.5	<0.0001	84.0	0.64	0.62, 0.67
Had asthma symptoms[f]	20 641	18 738 380	67.5	− 5.7	<0.0001	86.2	0.67	0.64, 0.70
Talked to doctor or taken asthma medication[g]	21 406	18 937 568	67.3	− 6.0	<0.0001	84.0	0.62	0.59, 0.65
Taken asthma medication or had asthma symptoms[h]	22 266	19 976 637	71.0	− 0.8	0.6685	88.7	0.72	0.70, 0.75
Talked to doctor or had asthma symptoms[i]	22 777	20 629 149	73.5	2.6	0.0019	86.5	0.66	0.63, 0.69
Talked to doctor, or taken asthma medication, or had asthma symptoms[j]	23 225	21 093 794	74.9	4.6	<0.0001	87.4	0.68	0.64, 0.71

[a]Unweighted sample size.
[b]Weighted sample size.
[c]An estimated 71.6% of those ever diagnosed with asthma had current asthma.
[d]Responded "within the past year" to: "How long has it been since you last talked to a doctor or other health professional about your asthma?"
[e]Responded "less than one day ago," "1–6 days ago," "1 week to less than 3 months ago," or "3 months to less than 1 year ago" to: "How long has it been since you last took asthma medication?"
[f]Responded "less than one day ago," "1–6 days ago," "1 week to less than 3 months ago," or "3 months to less than 1 year ago" to: "How long has it been since you last had any symptoms of asthma?"
[g]Affirmative responses to either question in footnotes d and e.
[h]Affirmative responses to either question in footnotes e and f.
[i]Affirmative responses to either question in footnotes d and f.
[j]Affirmative responses to at least one question in footnotes d, e and f.

Table 2. Distribution of persons with no current asthma who met modified active asthma criteria.

Active asthma criterion	%	95% CI
Talked to doctor[a]	32.7	25.4, 40.0
Taken asthma medication[b]	3.4	1.6, 5.1
Had asthma symptoms[c]	25.6	20.6, 30.5
Talked to doctor and taken asthma medication[d]	3.2	2.0, 4.3
Taken asthma medication and had asthma symptoms[e]	10.4	7.4, 13.5
Talked to doctor and had asthma symptoms[f]	4.7	3.0, 6.5
Talked to doctor, and taken asthma medication, and had asthma symptoms[g]	20.1	15.2, 25.0

[a]Responded "within the past year" to: "How long has it been since you last talked to a doctor or other health professional about your asthma?"
[b]Responded "less than one day ago", "1–6 days ago", "1 week to less than 3 months ago," or "3 months to less than 1 year ago" to: "How long has it been since you last took asthma medication?"
[c]Responded "less than one day ago," "1–6 days ago," "1 week to less than 3 months ago," or "3 months to less than 1 year ago" to: "How long has it been since you last had any symptoms of asthma?"
[d]Affirmative responses to questions in footnotes a and b.
[e]Affirmative responses to questions in footnotes b and c.
[f]Affirmative responses to questions in footnotes a and c.
[g]Affirmative responses to questions in footnotes a, b and c.

provide greater sensitivity and specificity than bronchial hyperresponsiveness, often considered a more objective measure, for general population surveys [36]. Although high sensitivity is desirable for screening, increases in the proportion of false positives may lead associations toward null when assessing asthma outcomes. Therefore, greater specificity is important in population studies seeking to assess risk factors, as those identified as having asthma will have a greater probability of truly having asthma [37].

In addition to data validity, additional attributes of an efficient and effective surveillance system should be considered including simplicity, data quality, acceptability, and resources needed to operate the system, among others [20]. Each question increases time and costs of data collection [38,39]. Furthermore, lengthier surveys tend to have reduced respondent cooperation, lower completion rates, and greater item non-response [40]. The current asthma classification requires fewer items to ascertain a case than the active asthma classification and is consistent with studies from other surveillance systems, such as the National Health Interview Survey and National Health and Nutrition Examination Survey [23,27].

Some respondents with current asthma were classified as not having active asthma because they reported not having asthma symptoms, not taking asthma medication, and not seeing a

Table 3. Characteristics of those with current asthma and those with active asthma—adults who were ever diagnosed with asthma, Asthma Call-back Survey, 2011–2012[a].

	Current asthma[b] ($n = 21\,916$)		Active asthma[c] ($n = 23\,225$)	
	%	95% CI	%	95% CI
Age				
18–44	48.6	46.8, 50.4	48.6	46.8, 50.4
45–64	35.2	33.7, 36.6	35.1	33.7, 36.5
≥65	16.2	15.3, 17.1	16.3	15.4, 17.2
Sex				
Male	35.9	34.1, 37.7	36.1	34.4, 37.9
Female	64.1	62.3, 65.9	63.9	62.1, 65.6
Race/ethnicity				
Non-Hispanic, White	68.1	66.2, 69.9	68.2	66.4, 70.0
Non-Hispanic, Black	12.1	10.8, 13.3	11.7	10.4, 13.0
Hispanic	12.5	11.0, 14.0	12.8	11.3, 14.3
Other	7.4	6.2, 8.5	7.3	6.3, 8.4
Education				
≤High school	40.8	39.1, 42.6	41.2	39.5, 43.0
Some college	34.3	32.6, 36.0	33.6	32.0, 35.2
College graduate	24.8	23.5, 26.2	25.2	23.9, 26.5
Household income				
<$15,000	20.8	19.1, 22.4	19.7	18.1, 21.2
$15,000–$24,999	19.7	18.3, 21.0	20.6	19.1, 22.1
$25,000–$34,999	10.4	9.3, 11.5	11.0	9.9, 12.2
$35,000–$49,999	11.9	10.7, 13.0	11.5	10.4, 12.5
≥$50,000	37.4	35.6, 39.1	37.2	35.5, 38.9
Insurance coverage				
Yes	86.9	85.6, 88.3	86.7	85.4, 88.0
No	13.1	11.8, 14.4	13.3	12.0, 14.6
Smoking status				
Current	22.3	20.7, 23.8	22.7	21.2, 24.2
Former	26.2	24.8, 27.7	26.5	25.1, 27.9
Never	51.5	49.8, 53.3	50.8	49.1, 52.6
Last talked to doctor				
<1 year	69.4	67.7, 71.2	72.2	70.6, 73.8
1–5 years	23.5	21.8, 25.1	21.0	19.5, 22.6
>5 years, never	7.1	6.2, 8.0	6.8	6.0, 7.6
Last taken asthma medicine				
<1 day–6 days	53.9	52.1, 55.7	52.0	50.3, 53.8
1 week–<1 year	28.1	26.4, 29.7	29.7	28.0, 31.3
>1 year, never	18.0	16.6, 19.5	18.3	16.8, 19.8
Last had asthma symptoms				
<1 day–6 days	49.2	47.5, 51.0	47.9	46.2, 49.6
1 week–<1 year	38.5	36.7, 40.2	41.8	40.1, 43.6
>1 year, never	12.3	10.9, 13.7	10.3	8.9, 11.7
Adverse asthma outcomes[d]				
Asthma attack	52.0	50.3, 53.8	50.9	49.1, 52.6
Urgent treatment	44.1	41.7, 46.5	46.1	43.7, 48.5
Emergency room visit	13.8	12.6, 15.0	13.6	12.4, 14.8
Hospital stay	3.7	3.2, 4.2	3.6	3.2, 4.1
Financial barriers				
Unable to see primary care doctor	13.7	12.5, 14.9	13.2	12.0, 14.3
Unable to see specialist	7.6	6.6, 8.5	7.5	6.5, 8.5
Unable to buy medication	19.4	18.1, 20.8	18.8	17.5, 20.1
At least one financial barrier	23.2	21.8, 24.7	22.7	21.3, 24.1
Asthma control				
Well controlled	47.1	45.3, 48.8	48.4	46.7, 50.2
Not well controlled	25.5	24.0, 27.1	25.1	23.6, 26.5
Very poorly controlled	27.4	25.9, 28.9	26.5	25.1, 28.0
Activity limitations				
Yes	35.6	33.9, 37.3	34.9	33.2, 36.5
No	64.4	62.7, 66.1	65.1	63.5, 66.8
Comorbid conditions				
Chronic Obstructive Pulmonary Disease	17.7	16.7, 18.7	17.5	16.5, 18.5
Emphysema	9.1	8.4, 9.8	9.0	8.3, 9.7
Bronchitis	31.2	29.6, 32.8	30.9	29.3, 32.4
Depression	38.4	36.7, 40.1	39.0	37.4, 40.7

(Continued on next page)

Table 3. (Continued)

	Current asthma[b] ($n = 21\,916$)		Active asthma[c] ($n = 23\,225$)	
	%	95% CI	%	95% CI
WRA[e]	16.0	14.1, 18.0	16.6	14.4, 18.9
Possible WRA[e]	40.7	37.9, 43.5	39.4	36.7, 42.1

[a]In 2012, cellular telephone households were added to the Asthma Call-back Survey landline telephone sampling frame. To combine 2012 with 2011 data, we used only data from the landline telephone household sample from both years.
[b]Responded "yes" to: "Do you still have asthma?"
[c]Responded "within the past year" to: "How long has it been since you last talked to a doctor or other health professional about your asthma?" or responded "less than one day ago", "1–6 days ago", "1 week to less than 3 months ago", or "3 months to less than 1 year ago" to either question: "How long has it been since you last took asthma medication?" or "How long has it been since you last had any symptoms of asthma?"
[d]In the past 12 months.
[e]Estimates based on 2012 landline household data because of questionnaire changes in 2012.

physician for their asthma in the last year. Gerritsen et al. found that approximately half of adults with childhood-onset asthma do not have asthma symptoms but still may respond to inhaled allergens [41]. These individuals may acknowledge that they still have the potential to have asthma symptoms if exposed to an asthmagen but effectively avoid their asthma triggers, thus would be misclassified by the active asthma classification.

Additionally, some respondents had active asthma, but indicated they did not have current asthma. These respondents reported having asthma symptoms, taking asthma medication, talking to a doctor, or any combination of the three. This misclassification may be explained, in part, by lack of asthma education and low health literacy among some respondents [6, 42]. For example, Federman et al. found that 54% of adults aged ≥60 years believed they only had asthma when their symptoms were present [42]. These respondents might deny still having asthma while responding affirmatively to the questions regarding talking to a physician about their asthma or taking asthma medications.

Furthermore, Zahran et al. found that approximately 5% of adults with asthma are not receiving any asthma education [6]. These individuals might not know how to properly recognize asthma symptoms or take asthma medications as prescribed. Consequently, these patients might deny still having asthma and report not having asthma symptoms or not taking asthma medication. However, because of talking to a doctor about their asthma, they would meet the criteria of active asthma classification. Moreover, some adults who reported they do not still have asthma were classified as having active asthma based on the asthma symptoms criterion only. We hypothesize that they met active asthma classification because they had asthma symptoms at some time in the last year, but denied still having asthma because they did not have symptoms at the time of the interview. Additional studies are needed to determine factors associated with the misclassification of asthma status.

Sa-Sousa et al. evaluated performance of seven different asthma classifications using data from the National Health and Nutrition Examination Survey and found that the asthma prevalence in the U.S. population can range from 1.1% to 17.2% [18]. In addition to using the question "do you still have asthma?" to assess current asthma, the authors recommended including questions on asthma attacks in the last 12 months and current asthma medication use when defining asthma in epidemiological studies. Pekkanen et al. suggested that using an asthma classification based on the presence of several asthma symptoms would increase the specificity of self-reported asthma compared to bronchial hyperresponsiveness [17]. Similarly, the Council for State and Territorial Epidemiologists recommend in their 1998 position statement to classify a probable asthma case using a combination of affirmative responses to the survey questions about respondent's still having asthma, or taking prescription medications for asthma, or having an episode of wheeze in the past year among those who have ever had a physician diagnosis of asthma [22]. The results of the present study, however, suggest that asthma symptoms and medication use perform well compared to the current asthma classification.

The strengths of this study include the use of two years of population-based survey data after the implementation of a new weighting methodology that reduces non-response bias and produces estimates more representative of the population [30]. However, this study also has some limitations. The landline only Asthma Call-back Survey sample may lack coverage of specific populations captured by the cellular telephone sample; however, the addition of the cellular telephone sample has been found to not affect asthma estimates [43,44]. Also, despite possible violation of independence due to limitations in the survey design, the kappa statistic offered an acceptable method for assessing agreement, and the calculation of the percent difference between current and active asthma offered comparable results. Moreover, respondents were required to estimate the time since they had last talked to a doctor, taken asthma medication, and had asthma symptoms, and may report events outside the actual time frame, leading to overestimation of results [45]. Furthermore, the BRFSS Asthma Call-back Survey was not designed to collect clinical and laboratory data; therefore, validation of the current or active asthma classifications was not feasible. Future studies should assess the validity of both the current and active asthma classifications. Small sample sizes resulted in large confidence intervals for some subgroup analyses. Results are not nationally representative or representative of non-participating states.

Conclusions

These results indicate the current asthma and active asthma classifications perform similarly using BRFSS Asthma Call-back Survey data to identify persons with asthma. An estimated 13% of persons had inconsistent information on their asthma status. The agreement with current asthma was strengthened

when talking to a doctor in the last year was removed from the active asthma classification, indicating that talking to a health-care professional about asthma may not correctly classify active asthma cases. Although the current asthma classification has the advantage of being comparable across multiple surveillance systems, the use of the active asthma classification may be warranted for certain research questions, such as when greater sensitivity or sample size is desired.

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Declaration of interest

The authors report no conflicts of interest. The findings and conclusion in this report are those of the authors and do not necessarily represent the official views of CDC or ASPPH.

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References

1. Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007. J Allergy Clin Immunol 2007;120(5 Suppl):S94–138.
2. Moorman JE, Akinbami LJ, Bailey CM, Zahran HS, King ME, Johnson CA, Liu X. National surveillance of asthma: United States, 2001–2010. Vital Health Stat 3 2012(35):1–67.
3. Sullivan PW, Ghushchyan VH, Slejko JF, Belozeroff V, Globe DR, Lin SL. The burden of adult asthma in the United States: evidence from the Medical Expenditure Panel Survey. J Allergy Clin Immunol 2011;127(2):363–369.
4. Mirabelli MC, Beavers SF, Chatterjee AB, Moorman JE. Age at asthma onset and subsequent asthma outcomes among adults with active asthma. Respir Med 2013;107(12):1829–1836.
5. Mirabelli MC, Beavers SF, Chatterjee AB. Active asthma and the prevalence of physician-diagnosed COPD. Lung 2014;192(5):693–700.
6. Zahran HS, Person CJ, Bailey C, Moorman JE. Predictors of asthma self-management education among children and adults–2006–2007 Behavioral Risk Factor Surveillance System Asthma Call-back Survey. J Asthma 2012;49(1):98–106.
7. Nguyen K, Zahran H, Iqbal S, Peng J, Boulay E. Factors associated with asthma control among adults in five New England states, 2006–2007. J Asthma 2011;48(6):581–588.
8. Knoeller GE, Mazurek JM, Moorman JE. Health-related quality of life among adults with work-related asthma in the United States. Qual Life Res 2013;22(4):771–780.
9. Knoeller GE, Mazurek JM, Moorman JE. Asthma symptoms among adults with work-related asthma. J Asthma 2013;50(2):166–173.
10. Knoeller GE, Mazurek JM, Moorman JE. Work-related asthma among adults with current asthma in 33 states and DC: evidence from the Asthma Call-Back Survey, 2006–2007. Public Health Rep 2011;126(4):603–611.
11. Knoeller GE, Mazurek JM, Moorman JE. Characteristics associated with health care professional diagnosis of work-related asthma among individuals who describe their asthma as being caused or made worse by workplace exposures. J Occup Environ Med 2012;54(4):485–490.
12. White GE, Mazurek JM, Moorman JE. Work-related asthma and employment status—38 states and District of Columbia, 2006–2009. J Asthma 2013;50(9):954–959.
13. White GE, Mazurek JM, Moorman JE. Asthma in health care workers: 2008 and 2010 Behavioral Risk Factor Surveillance System Asthma Call-back Survey. J Occup Environ Med 2013;55(12):1463–1468.
14. Lutzker LA, Rafferty AP, Brunner WM, Walters JK, Wasilevich EA, Green MK, Rosenman KD. Prevalence of work-related asthma in Michigan, Minnesota, and Oregon. J Asthma 2010;47(2):156–161.
15. Tice CJ, Cummings KR, Gelberg KH. Surveillance of work-related asthma in New York state. J Asthma 2010;47(3):310–316.
16. Zahran HS, Bailey CM, Qin X, Moorman JE. Assessing asthma control and associated risk factors among persons with current asthma - findings from the child and adult Asthma Call-back Survey. J Asthma 2014;1–9.
17. Pekkanen J, Sunyer J, Anto JM, Burney P. Operational definitions of asthma in studies on its aetiology. Eur Respir J 2005;26(1):28–35.
18. Sa-Sousa A, Jacinto T, Azevedo LF, Morais-Almeida M, Robalo-Cordeiro C, Bugalho-Almeida A, Bousquet J, et al. Operational definitions of asthma in recent epidemiological studies are inconsistent. Clin Translation Allergy 2014;4:24–35.
19. Van Wonderen KE, Van Der Mark LB, Mohrs J, Bindels PJ, Van Aalderen WM, Ter Riet G. Different definitions in childhood asthma: how dependable is the dependent variable? Eur Respir J 2010;36(1):48–56.
20. German RR, Lee LM, Horan JM, Milstein RL, Pertowski CA, Waller MN. Updated guidelines for evaluating public health surveillance systems: recommendations from the Guidelines Working Group. MMWR Recomm Rep 2001;50(RR-13):1–35.
21. Council of State and Territorial Epidemiologists. Environmental and Chronic Disease Committees. Asthma: a continuing public health priority. CSTE Position Statement 2010-EH-012010. Available at: http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PS/10-EH-01.pdf [last accessed 12 March 2015].
22. Council of State and Territorial Epidemiologists. Environmental and Chronic Disease Committees. Asthma Surveillance and Case Definition. 1998. Updated June. Available from: http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PS/1998-EHCD-1.pdf [last accessed 12 March 2015].
23. Centers for Disease Control and Prevention. Asthma Survey Questions. 2015. Updated 23 April; Available from: http://www.cdc.gov/asthma/questions.htm [last accessed 12 May 2015].
24. Council of State and Territorial Epidemiologists. Occupational Health Indicators: A Guide for Tracking Occupational Conditions and Determinants. Atlanta, GA: Council of State and Territorial Epidemiologists; 2014.
25. U.S. Department of Health and Human Services. Healthy People 2020. Respiratory Diseases. Washington, DC. Available from: http://www.healthypeople.gov/2020/topics-objectives/topic/respiratory-diseases/objectives [last accessed 12 May 2015].
26. Akinbami LJ, Moorman JE, Liu X. Asthma prevalence, health care use, and mortality: United States, 2005–2009. National Health Statistics Repts 2011(32):1–14.
27. Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System. 2013. Updated March 19. Available from: http://www.cdc.gov/brfss/about/index.htm [last accessed 27 October 2014].
28. Centers for Disease Control and Prevetion (CDC). BRFSS Asthma Call-back Survey. 2014. Updated June 9. Available from: http://www.cdc.gov/brfss/acbs/index.htm [last accessed 27 October 2014].
29. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System 2012 Summary Data Quality Report. 2013. Available from: http://www.cdc.gov/brfss/annual_data/2012/pdf/summarydataqualityreport2012_20130712.pdf [last accessed 12 May 2015].
30. Centers for Disease Control and Prevention (CDC). Methodologic changes in the Behavioral Risk Factor Surveillance System in 2011

and potential effects on prevalence estimates. MMWR Morb Mortal Wkly Rep 2012;61(22):410–413.
31. Knoeller GE, Mazurek JM, Moorman JE. Work-related asthma, financial barriers to asthma care, and adverse asthma outcomes: asthma call-back survey, 37 states and District of Columbia, 2006 to 2008. Med Care 2011;49(12):1097–1104.
32. Viera AJ, Garrett JM. Understanding interobserver agreement: the kappa statistic. Fam Med 2005;37(5):360–363.
33. Toren K, Brisman J, Jarvholm B. Asthma and asthma-like symptoms in adults assessed by questionnaires. A literature review. Chest 1993;104(2):600–608.
34. Senthilselvan A, Dosman JA, Chen Y. Relationship between pulmonary test variables and asthma and wheezing: a validation of self-report of asthma. J Asthma 1993;30(3):185–193.
35. Jenkins MA, Clarke JR, Carlin JB, Robertson CF, Hopper JL, Dalton MF, Holst DP, et al. Validation of questionnaire and bronchial hyperresponsiveness against respiratory physician assessment in the diagnosis of asthma. Int J Epidemiol 1996;25(3):609–616.
36. Pearce N, Beasley R, Pekkanen J. Role of bronchial responsiveness testing in asthma prevalence surveys. Thorax 2000;55(5):352–354.
37. Kilpelainen M, Terho EO, Helenius H, Koskenvuo M. Validation of a new questionnaire on asthma, allergic rhinitis, and conjunctivitis in young adults. Allergy 2001;56(5):377–384.
38. Ehrlich E. Criteria and Procedures for Addition of Data Items. Available from: https://dphhs.mt.gov/Portals/85/publichealth/documents/BRFSS/MTBRFSSCriteriaAndProceduresAddData.pdf [last accessed 20 May 2015].
39. Delaware Health and Social Services Division of Public Health. How data items are added to the Delaware BRFS. 2013. Available from: http://www.dhss.delaware.gov/dph/dpc/addpolicy.html [last accessed 5 May 2015].
40. Sinkowitz-Cochran RL. Survey design: To ask or not to ask? That is the question. Clin Infect Dis 2013;56(8):1159–1164.
41. Gerritsen J, Koeter GH, de Monchy JG, van Lookeren Campagne JG, Knol K. Change in airway responsiveness to inhaled house dust from childhood to adulthood. J Allergy Clin Immunol 1990;85(6):1083–1089.
42. Federman AD, Wolf M, Sofianou A, Wilson EA, Martynenko M, Halm EA, Leventhal H, et al. The association of health literacy with illness and medication beliefs among older adults with asthma. Patient Educ Couns 2013;92(2):273–278.
43. Kanotra S, Siameh S. Effect of Changes in BRFSS Protocols on 2011 Behavioral Risk Factor Surveillance Data in Kentucky. Frankfort, KY: Cabinet for Health and Family Services, Kentucky Department for Public Health; 2012 June. Available from: http://chfs.ky.gov/NR/rdonlyres/78F10DF3-ADBC-4588-9207-056A476B2071/0/EffectofChangesinBRFSSProtocolson2011-BRFSSDatainKY.pdf [last accessed 4 November 2014].
44. Hu SS, Balluz L, Battaglia MP, Frankel MR. Improving public health surveillance using a dual-frame survey of landline and cell phone numbers. Am J Epidemiol 2011;173(6):703–711.
45. Gaskell GD, Wright DB, O'Muircheartaigh CA. Telescoping of landmark events: implications for survey research. Public Opin Q 2000;64(1):77–89.