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Impaired Health-related Quality of Life and Related Risk Factors among U.S. Adults with Asthma

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Abstract

Objective—This study assessed Health-related Quality of Life (HRQoL) and related risk factors among adults with asthma in the United States. Using the 2015 Behavioral Risk Factor Surveillance System (BRFSS), we examined the association between four domains of impaired HRQoL and selected explanatory factors.

Methods—A BRFSS sample of 39 321 adults with asthma was used in this study. We examined the association between fair/poor health, 14 mentally unhealthy days, 14 physically unhealthy days, and 14 days of activity limitation and selected explanatory variables (sex, race/ethnicity, age, annual household income, healthcare coverage, physical activity, smoking status, Body Mass Index (BMI), having a coexisting disease, and being diagnosed with depression) using multivariable logistic regression models.

Results—Income, physical activity status, smoking status, coexisting diseases, and depression were strongly associated with all HRQoL domains. Blacks had significantly less 14 physically unhealthy days (23.4%; aPR = 0.82 [95% CI: 0.72, 0.92]) and 14 days of activity limitation (18.3%; aPR = 0.81 [0.70, 0.94]) and Hispanics had significantly more fair/poor health (38.4%; aPR= 1.31 [1.18, 1.45]) than whites. Underweight and obese had significantly more fair/poor health, and underweight significantly more 14 physically unhealthy days, compared with normal weight. Adults aged 55 years or older had significantly less 14 mentally unhealthy days than adults 18–24 years.

Conclusions—Multiple factors were associated with impaired HRQoL. Providing strategies to address potential risk factors such as low income, physically inactive, smoker, and obese or underweight should be considered to improve HRQoL among adults with asthma.

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Author's Notes

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention/the Agency for Toxic Substances and Disease Registry.

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Introduction

In 2015, 7.6% (18.4 million) of the U.S. adult population had asthma [1]. Asthma prevalence has increased in the last decade, at an annual percentage rate of 1.5% from 2001 to 2010 [2]. Asthma, which costs the nation \$56 billion annually [3], also takes a significant toll on the population, causing 439 000 hospital discharges [4], 1.6 million emergency department visits [5], and 3651 deaths annually [6].

Asthma is a disease characterized by inflammation of the airways, obstruction of airflow, and bronchial hyperresponsiveness and symptoms include wheezing, coughing, tightness of the chest, shortness of breath, and sleep awakenings. These symptoms can greatly affect persons with asthma in their daily activities and quality of life [7]. Therefore, understanding how quality of life is impaired among the increasing percentage of people living with asthma is especially important in understanding the current impact of asthma.

Numerous published studies have demonstrated impaired health-related quality of life (HRQoL) among adults with asthma. One study [8] determined that self-rated health, physical and mental domain impairments, and activity limitations as measured by the four Behavioral Risk Factor Surveillance System (BRFSS) HRQoL indicators, were significantly impaired among adults with asthma. Cui et al. [9] who measured these four HRQoL indicators on the National Health and Nutrition Examination Survey (NHANES), determined that only adolescents having asthma with symptoms had worse HRQoL. Adams et al. [10] found that Australian adults with asthma also reported more comorbid conditions, higher activity limitations measured by the Short Form-12 (SF-12), and a significantly decreased physical activity domain of the SF-12 compared with adults without asthma. Vietri et al. [11] found significantly impaired HRQoL among U.S. workers with poor asthma control, compared with well-controlled asthma, after adjusting for confounders. The study found impaired 12-item Short Form Survey Instrument (SF-12v2) physical health and mental health component scores and SF-6D health utility scores.

Decreased QoL has been associated with a number of risk factors among adults with asthma including being female [12, 13], older age [14, 15], smoking [16], lower income [15, 17], comorbidities [10, 15, 18], physical inactivity [16], obesity [16, 19, 20], poor mental health [13, 21, 22], poor asthma control [13, 18, 23, 24], and asthma severity [15, 19, 25]. However, most studies are outdated and a limited number of studies [8, 9, 16, 26] evaluated/assessed HRQoL among adults with asthma using the Centers for Disease Control and Prevention (CDC) HRQoL measure. Only one of those studies [9] using the CDC HRQoL measure was published within the last 10 years and was conducted among adolescents.

The aim of this study was to examine the association between the four domains of HRQoL indicators (i.e., self-rated health, mentally unhealthy days, physically unhealthy days, and activity limitation days) and selected explanatory factors which included sociodemographic, behavioral, and health status indicators, among adults with asthma using the 2015 Behavioral Risk Factor Surveillance System (BRFSS). We hypothesized that demographic, socioeconomic, and behavioral factors, and comorbid conditions (e.g., sex, race/ethnicity, age, annual household income, healthcare coverage, physical activity, smoking status, Body

Mass Index (BMI), having a coexisting disease, and being diagnosed with depression) will be associated with lower quality of life among adults with asthma.

Methods

This cross-sectional study includes a sample of 39 321 non-institutionalized adults aged 18 years and older with current asthma, in the United States including the District of Columbia, who completed the 2015 Behavioral Risk Factor Surveillance System (BRFSS) with and without asthma. BRFSS is a state-based, random-digit-dialed telephone survey of non-institutionalized U.S. adults. BRFSS monitors the prevalence of key health conditions, risk behaviors, and preventive health practices that can affect health status [27]. Data from all states and the District of Columbia were pooled to produce national estimates. The data include sample weights to adjust for nonresponse differences in the sample and unequal probability of sample selection [27]. The median survey response rate for all states, territories and Washington, DC, in 2015 was 47.2, and ranged from 33.9 to 61.1 (https://www.cdc.gov/brfss/annual_data/2015/pdf/2015-sdqr.pdf). Determination of asthma status was based on two core questions on the BRFSS: “Has a doctor, nurse, or other health professional EVER told you that you had any of the following? (Ever told) you had asthma?” and “Do you still have asthma?” A person was classified as current asthma if he or she responded yes to both questions.

Multiple associations between HRQoL indicators and explanatory factors (sociodemographic, behavioral, and health status indicators) were examined. Analysis variables included sex (male or female), race/ethnicity (non-Hispanic white, non-Hispanic black, non-Hispanic American Indian/Alaskan Native, non-Hispanic Asian, non-Hispanic other, or Hispanic), age group (18–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years, or 65 years or older), annual household income (<\$15 000, \$15 000–\$24 999, \$25 000–\$34 999, \$35 000–\$49 000, or \$50 000), healthcare coverage (yes or no), physical activity (physically active or physically inactive), smoking status (never smoker, past smoker, or current smoker), Body Mass Index (BMI) (underweight= 12 kg/m^2 BMI < 18.5 kg/m², normal weight= 18.5 kg/m² BMI < 25 kg/m², overweight= 25 kg/m² BMI < 30 kg/m², obese= 30 kg/m² BMI), coexisting diseases (yes or no) and depression (yes or no). Coexisting diseases included heart disease, stroke, cancer, chronic obstructive pulmonary disease (COPD), arthritis, kidney disease, diabetes, and hypertension. The “other NH” category included non-Hispanic multiracial, Native Hawaiian or other Pacific Islander, and other races. For the remainder of the document, racial groups mentioned including white, black, American Indian/Alaskan Native, Asian, and other are assumed non-Hispanic.

We used the CDC Healthy Days (CDC HRQoL-4) scale to measure HRQoL. This scale includes the following standard 4-item set of healthy days questions that have been included on the BRFSS questionnaire since 1993 (https://www.cdc.gov/hrqol/hrqol14_measure.htm):

- “Would you say that in general your health is—excellent, very good, good, fair, or poor?” (self-rated health)

- “Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?” (mentally unhealthy days)
- “Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?” (physically unhealthy days)
- “During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?” (activity limitation days)

In addition to “no activity limitation” responses, if the respondent reported “no” physically and mentally unhealthy days, and responses to activity limitation day question were missing, then the number of days of activity limitation was considered as “none.”

Following the CDC HRQoL program guidelines (<https://www.cdc.gov/hrqol/index.htm>), responses to the HRQoL measures were dichotomized as having 14 or more versus less than 14 mentally or physically unhealthy days, or days of activity limitation. Responses to the self-rated health question were dichotomized as “having fair or poor health” and “not having fair or poor health,” which includes responses “good, very good, and excellent health.”

Smoking status was determined according to two core questions on the BRFSS: “Have you smoked at least 100 cigarettes in your entire life?” and “Do you now smoke cigarettes every day, some days, or not at all?” Respondents were categorized as a current smoker if they answered “yes” on both questions and as a past smoker if they answered “yes” to the first question and “no” to the second question. Respondents who reported no participation in physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise in the past month were considered physically inactive. (2015 BRFSS Questionnaire: <https://www.cdc.gov/brfss/questionnaires/pdf-ques/2015-brfss-questionnaire-12-29-14.pdf>)

Statistical analysis

All statistical analyses were done in SAS 9.4-callable SUDAAN to account for the complex sampling design of the BRFSS. Sample weights were used during the analyses to produce estimates generalizable to a participating state’s population. Chi-square tests were conducted to determine statistical significance in the difference of current asthma prevalence by potential risk factor variables. For variables with more than two categories, we determined statistical significance difference between subpopulation groups if the 95% CI’s of the estimates did not overlap and confirmed with t-tests if $p < 0.05$. Logistic regression models were used to test for association between the dependent variable (each HRQoL indicator) and potential risk factors as independent variables (sex, race/ethnicity, age, income, health care coverage, physical activity, smoking, BMI, coexisting diseases, and depression) among adults with asthma. For each HRQoL indicator, we calculated weighted percentages of each risk factor and constructed logistic regression models. Unadjusted logistic regression models contained a single risk factor to calculate the unadjusted prevalence ratios (PRs). The adjusted logistic regression models contained all risk factors to determine the adjusted prevalence ratios (aPRs) (also known as predicted marginal risk ratio). Corresponding 95%

confidence intervals (CIs) were determined for each estimate. The PR and aPR values were considered statistically significant if the null value of 1 was not within the 95% CI of PRs.

Results

Characteristics

Overall 8.8% of survey respondents 18 years and older had current asthma (results not shown). All potential risk factors in Table 1 showed a statistically significant difference in current asthma prevalence ($p < 0.0000$ for all variables). Significantly more females (weighted, %: 11.3%; 95% CI: 11.0, 11.5) had current asthma compared with males (6.2%; 6.0, 6.4). American Indian/Alaskan Native adults had the significantly highest (16.1%; 14.4, 18.0) and Asian adults had the significantly lowest asthma prevalence (5.2%; 4.4, 6.1), compared with all other race/ethnic groups. Prevalence was significantly higher among adults aged 18–24 years (10.3%; 9.7, 11.0) than adults of all other ages. Asthma prevalence was significantly higher among adults who had income less than \$15 000 (14.1%; 13.5, 14.8), had health care coverage (9.1%; 8.9, 9.3), were physically inactive (10.8%; 10.4, 11.1), were a current smoker (11.5%; 11.0, 11.9), and were obese (12.5%; 12.1, 12.9) than adults who did not have these characteristics in the corresponding categories (Table 1). In addition, asthma was significantly more prevalent among adults reporting adverse health outcomes (i.e., one or more coexisting diseases and depression) than those who did not report them (Table 1).

HRQoL among adults with current asthma

Overall, 33.1% of adults with asthma reported having fair/poor health, 22.9% had 14 mentally unhealthy days, 25.2% had 14 physically unhealthy days, and 18.8% had 14 days of activity limitation (data not shown). Females were significantly less likely to report fair/poor health than males (unadjusted prevalence: 34.0%; adjusted prevalence ratio (aPR) = 0.92 [95% CI: 0.86, 0.98] versus 31.5% for males), after adjustment (Table 2). No other differences in HRQoL were observed between females and males after adjustment (Table 2 and Table 3).

Most of the observed significant associations between race/ethnicity and HRQoL measures were present before adjustment (Table 2 and Table 3). Blacks were significantly more likely to report fair/poor health compared with whites, but the differences became not statistically significant after adjustment. After adjustment, blacks were significantly less likely to report 14 physically unhealthy days (23.4%; aPR = 0.82 [0.72, 0.92]) and 14 days of activity limitation (18.3%; aPR = 0.81 [0.70, 0.94]), compared with whites (25.5% and 18.8%, respectively). Hispanics were significantly more likely to report fair/poor health, which remained significant even after adjusting for confounding factors (38.4%; aPR = 1.31 [1.18, 1.45]) versus 31.1% for whites. American Indian/Alaska Natives were significantly more likely to report statistically higher values in all four HRQoL domains compared with whites, but the differences were only statistically significant after adjustment for fair/poor health (50.6%; aPR = 1.25 [1.06, 1.46]) compared with whites (31.1%). Asians were significantly less likely to report all four HRQoL domains compared with whites, which became not statistically significant after adjustment. (Table 2 and Table 3)

Older adults were significantly more likely to report fair/poor health, 14 physically unhealthy days, and 14 days of activity limitation compared with adults aged 18–24 years. Adults aged 55–64 years (24.3%; aPR= 0.77 [0.65, 0.92]) and 65 years (14.5%; aPR= 0.59 [0.49, 0.71]) were significantly less likely to report 14 mentally unhealthy days compared with 18–24 year olds (22.9%). (Table 2 and Table 3)

Fair/poor health, 14 mentally unhealthy days, 14 physically unhealthy days, and 14 days of activity limitation were significantly more prevalent among adults with income less than \$50 000 compared with adults with income of \$50 000 or more, even after adjusting for confounding factors (Table 2 and Table 3). Compared with having income of \$50 000, having income of <\$15 000 was strongly significantly associated with having fair/poor health (60.3%; aPR=2.43 [2.21, 2.68]), 14 mentally unhealthy days (39.2%; aPR=1.75 [1.54, 1.98]), 14 physically unhealthy days (46.4%; aPR=2.40 [2.13, 2.70]), and 14 days of activity limitation (38.3%; aPR=2.54 [2.21, 2.93]).

Significantly more adults without health care coverage reported fair/poor health and 14 mentally unhealthy days than adults with asthma who had healthcare coverage. The difference did not remain statistically significant after adjustment. Whereas, having 14 physically unhealthy days was significantly lower in adults without health care coverage (23.2%; aPR= 0.81 [0.70, 0.93]) than in adults with health care coverage (25.4%) (Table 2 and Table 3).

Significantly higher prevalence values of fair/poor health, 14 mentally unhealthy days, 14 physically unhealthy days, and 14 days of activity limitation were strongly significantly associated with physical inactivity, current or past smoking, one or more coexisting disease, and depression, regardless of adjusting for other confounding factors (Table 2 and Table 3).

Underweight adults were significantly more likely to report fair/poor health (44.1%; aPR= 1.45 [1.16, 1.80]) and 14 physically unhealthy days (35.9%; aPR= 1.43 [1.09, 1.88]) and obese adults were significantly more likely to report fair/poor health (42.5%; aPR= 1.22 [1.13, 1.32]) compared with normal weight adults (24.2% for fair/poor health and 19.7% for 14 physically unhealthy days). Obese adults were significantly more likely to have 14 mentally unhealthy days, 14 physically unhealthy days, and 14 days of activity limitation, but the differences were no longer significant after adjusting for confounders. (Table 2 and Table 3)

Discussion

This cross-sectional study was the first to examine HRQoL indicators among adults 18 years and older with asthma using the BRFSS, a large-scale survey, after its major survey methodology revision in 2011. This study determined that multiple sociodemographic, behavioral, and health status indicators were associated with impaired HRQoL among adults with asthma in the United States. Income, physical activity status, smoking status, coexisting diseases, and depression were associated with impaired HRQoL in all four dimensions: fair/poor self-rated health, frequent mentally unhealthy days, frequent physically unhealthy days, and frequent days of activity limitation. These results follow other published results that

multiple risk factors are associated with impaired HRQoL, including physical inactivity [16], smoking [16], comorbidities [10, 18], and depression [12].

A previous study demonstrated that adults 65 years and older with asthma have better mental health than younger adults [26]. It has been suggested that older people are less likely to recognize and report psychological problems [28].

Our findings indicate that females had significantly higher fair/poor self-rated health than males before adjustment with confounding factors (sex, race/ethnicity, age, income, health care coverage, physical activity, smoking, BMI, coexisting diseases, and depression) included in this study, but was significantly lower after adjustment. Similar to other studies [12, 24], this suggests the importance of the effects of the confounding factors on the association between being a female and having fair/poor health. Böhmer, et al. found that the association between the mental health score of the Short Form 12 Health Survey Questionnaire and being a female adult with asthma was not significant, after adjusting for confounding factors [12]. Another study also found after adjustment with confounders, gender was not associated with asthma-related quality of life in the asthma symptoms, activity limitation, and emotional function domains [24]. Another study finding was that the prevalence of 14 physically unhealthy days and 14 days of activity limitations among blacks with asthma was similar to that of whites before adjustment but became lower among blacks after adjusting for confounding factors. This finding can be also explained by the effects of confounding factors on the association between black adults with asthma, and HRQoL.

The association between lower socioeconomic status and impaired HRQoL is a finding shared by Ford et al. [8]. The study also found that among adults with asthma, low annual household income was strongly associated with having fair poor health, 14 physically unhealthy days, or 14 days of activity limitations. Phillips et al. [29] showed that lower income was associated with fair/poor health. Ejebe et al. [30] determined that those of lower socioeconomic status have decreased asthma self-efficacy, which could contribute to the HRQoL outcomes observed. Archea et al. [17] found that negative life events significantly impaired asthma-specific HRQoL among adults with lower income. Adults with low income generally have fewer psychosocial and material resources to manage their disease [31].

Hispanics with asthma in our study had significantly higher fair/poor health compared to whites, agreeing with a previously published study [16]. Jylhä [32] determined that cultures rate their health differently based on differing frameworks in evaluating one's own health within their own cultural contexts and environmental influences. Studies [31, 33] have determined that interview language for Hispanics was significantly associated with fair/poor health. Sanchez & Vargas found that when the commonly used Spanish translation of *regular* is given for the "fair" response, more respondents select this category [34]. Additionally, stressors and barriers to asthma management experienced by Hispanics [35] may also contribute to this impaired HRQoL.

This study determined that having depression was strongly associated with impaired HRQoL in all four domains. Another study demonstrated that reporting symptoms of depression in

adults with asthma was significantly associated with impaired health-related quality of life on Short Form 12 Health Survey Questionnaire (SF-12) physical and mental health scores [12].

Similar to other studies, our findings indicate that underweight and obesity were associated with HRQoL measures. Other studies found that overweight and/or obese adults with asthma were significantly associated with having fair/poor health [19, 31], worse asthma control [13, 36], and impaired health-related quality of life in physical domains [37, 38, 39]. Obesity-related comorbidities have been shown to mediate the association between obesity and health-related quality of life, especially in physically oriented domains [38]. Adjusting for comorbidities in the model, could have potentially contributed to the lack of association with physically unhealthy days and days of activity limitation demonstrated in this study.

The finding that underweight adults with asthma had higher fair/poor health and 14 physically unhealthy days could be attributed partly to illnesses causing reduced body weight not included in the comorbidities (such as anorexia, bulimia, and autoimmune disease). Liu et al. [40] found that the underweight group had worse respiratory symptoms compared with normal weight, which could have contributed to increased 14 physically unhealthy days in our study. Although, we did not measure respiratory symptoms nor assess effects of comorbidities causing underweight BMI (i.e. anorexia, bulimia, autoimmune disease) to be certain of this.

Since BRFSS is a cross-sectional survey, only disease prevalence values and associations with risk factors could be measured and causal relationships could not be determined. Also, HRQoL measures are subject to recall bias since they are self-reported. Another limitation of this study is that we were unable to control the effects from all confounders. Accordingly, the BRFSS data do not contain questions on asthma control status, asthma severity status, symptoms, occupational exposure, or asthma treatment status, which may alter the results. Using the Asthma Quality of Life Questionnaire (AQLQ) and the generic health status measure EuroQol 5-D (EQ-5D), Chen et al. [41] demonstrated that asthma control at baseline was a significant independent predictor of asthma-specific HRQoL. Erickson et al. [15] found that asthma disease severity was an important predictor of HRQoL particularly in the physical domains, which could have affected the outcomes. Although, we could not measure disease severity from the BRFSS. Lastly, the HRQoL measures on the BRFSS were not asthma-specific. Further studies could use an asthma-specific questionnaire, such as the Asthma Quality of Life Questionnaire (AQLQ), to determine risk factors that impair quality of life among adults with asthma.

Conclusion

Multiple sociodemographic, behavioral, and health status indicators were associated with impaired HRQoL among adults with asthma in the United States. Providing strategies to address potential risk factors such as low income, physical inactivity, smoking, and obesity or underweight should be considered to improve HRQoL among adults with asthma.

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Table 1
Prevalence of Current Asthma among Adults by Selected Sociodemographic, Behavioral, and Health Status Variables, 2015 Behavioral Risk Factor Surveillance System

Characteristics	Percent with current asthma	
	Unweighted, n	Weighted, % (95% CI)
Total	39 321	
Sex		* p<0.0000
Male	11 696	6.2 (6.0, 6.4)
Female	27 625	11.3 (11.0, 11.5)
Race/ethnicity		* p<0.0000
White NH	29 528	9.0 (8.8, 9.2)
Black NH	3865	10.7 (10.1, 11.3)
American Indian/Alaskan Native NH	932	16.1 (14.4, 18.0)
Asian NH	503	5.2 (4.4, 6.1)
Other NH	1425	12.9 (11.8, 14.2)
Hispanic	2476	7.0 (6.6, 7.5)
Age, year range		* p<0.0000
18–24	2384	10.3 (9.7, 11.0)
25–34	3675	8.4 (7.9, 8.8)
35–44	4570	8.4 (8.0, 8.8)
45–54	6789	8.9 (8.6, 9.3)
55–64	9045	9.3 (8.9, 9.7)
65	12 510	8.3 (8.0, 8.6)
Annual household income		* p<0.0000
<\$15 000	5792	14.1 (13.5, 14.8)
\$15 000–\$24 999	6467	10.6 (10.1, 11.2)
\$25 000–\$34 999	3481	8.5 (7.9, 9.0)
\$35 000–\$49 999	4176	8.2 (7.7, 8.7)
\$50 000	12 573	7.3 (7.0, 7.5)
Healthcare coverage		* p<0.0000
Yes	36 690	9.1 (8.9, 9.3)

Characteristics	Percent with current asthma	
	Unweighted, n	Weighted, % (95% CI)
No	2482	6.9 (6.4, 7.4)
Physical activity		* p<0.0000
Physically active	24 173	8.2 (8.0, 8.4)
Physically inactive	11 929	10.8 (10.4, 11.1)
Smoking status		* p<0.0000
Never smoker	19 446	8.1 (7.9, 8.4)
Past smoker	11 338	9.1 (8.8, 9.5)
Current smoker	7138	11.5 (11.0, 11.9)
BMI		* p<0.0000
Underweight	618	8.7 (7.4, 10.1)
Normal weight	9102	7.2 (6.9, 7.4)
Overweight	11 106	7.6 (7.3, 7.8)
Obese	14 999	12.5 (12.1, 12.9)
Coexisting diseases ^a		* p<0.0000
Yes	29 812	11.5 (11.2, 11.7)
No	9509	6.2 (6.0, 6.4)
Depression		* p<0.0000
Yes	13 858	17.5 (16.9, 18.0)
No	25 214	7.0 (6.8, 7.1)

Abbreviations: CI, confidence interval; NH, non-Hispanic

^aCoexisting diseases include heart disease, stroke, cancer, chronic obstructive pulmonary disease (COPD), arthritis, kidney disease, diabetes, and hypertension

* p-value for the chi-square test of association between current asthma status and selected variables

Table 2

Factors associated with fair/poor health and 14 mentally unhealthy days among adults with current asthma, 2015 Behavioral Risk Factor Surveillance System^a

Characteristics	Fair/poor self-rated health		14 mentally unhealthy days		Fair/poor self-rated health		14 mentally unhealthy days	
	Unadjusted prev, % (95% CI)	Adjusted PR (95% CI)	Unadjusted prev, % (95% CI)	Adjusted PR (95% CI)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)
Total	33.1 (32.2, 34.0)		22.9 (22.1, 23.8)		1.00		1.00	
Sex								
Male	31.5 (29.9, 33.2)		20.3 (18.8, 21.9)		1.00		1.00	
Female	34.0 (32.9, 35.0)		24.3 (23.3, 25.3)		1.08 (1.01, 1.14)		1.20 (1.10, 1.30)	0.99 (0.91, 1.08)
Race/ethnicity								
White NH	31.1 (30.2, 32.1)		22.3 (21.3, 23.2)		1.00		1.00	
Black NH	36.0 (33.4, 38.7)		23.0 (20.5, 25.7)		1.16 (1.07, 1.25)		1.03 (0.92, 1.16)	1.00 (0.87, 1.14)
American Indian/Alaskan Native NH	50.6 (44.4, 56.8)		34.8 (28.9, 41.2)		1.63 (1.43, 1.85)		1.56 (1.30, 1.88)	0.98 (0.78, 1.22)
Asian NH	19.9 (14.0, 27.5)		14.1 (9.4, 20.7)		0.64 (0.46, 0.90)		0.63 (0.43, 0.94)	1.01 (0.70, 1.46)
Other NH	41.7 (37.0, 46.6)		32.5 (27.8, 37.6)		1.34 (1.19, 1.51)		1.46 (1.20, 1.49)	1.21 (1.04, 1.42)
Hispanic	38.4 (35.0, 42.0)		24.5 (21.4, 28.0)		1.23 (1.12, 1.36)		1.10 (0.96, 1.27)	1.06 (0.91, 1.22)
Age, year range								
18–24	16.5 (14.2, 19.2)		22.9 (20.1, 25.9)		1.00		1.00	
25–34	21.6 (19.3, 24.1)		24.4 (21.9, 27.1)		1.30 (1.08, 1.58)		1.07 (0.91, 1.26)	1.01 (0.85, 1.20)
35–44	27.9 (25.8, 30.2)		24.3 (22.2, 26.5)		1.69 (1.42, 2.01)		1.06 (0.91, 1.24)	0.96 (0.81, 1.13)
45–54	40.3 (38.3, 42.4)		28.0 (26.1, 29.9)		2.44 (2.07, 2.87)		1.38 (1.13, 1.68)	0.95 (0.81, 1.12)
55–64	46.3 (44.3, 48.3)		24.3 (22.6, 26.1)		2.80 (2.39, 3.28)		1.06 (0.92, 1.23)	0.77 (0.65, 0.92)
65	42.2 (40.5, 44.0)		14.5 (13.2, 15.9)		2.55 (2.18, 2.99)		1.36 (1.11, 1.66)	0.64 (0.54, 0.74)
Annual household income								
<\$15 000	60.3 (57.7, 62.8)		39.2 (36.8, 41.6)		3.88 (3.54, 4.24)		2.43 (2.21, 2.68)	1.75 (1.54, 1.98)
\$15 000–\$24 999	44.4 (41.9, 46.9)		31.4 (29.0, 33.9)		2.85 (2.59, 3.15)		1.95 (1.76, 2.15)	1.67 (1.47, 1.89)
\$25 000–\$34 999	34.2 (31.2, 37.3)		20.3 (17.7, 23.1)		2.20 (1.95, 2.47)		1.61 (1.43, 1.82)	1.21 (1.04, 1.41)
\$35 000–\$49 999	25.7 (23.2, 28.4)		18.1 (15.7, 20.8)		1.65 (1.45, 1.88)		1.34 (1.18, 1.51)	1.23 (1.05, 1.44)
\$50 000	15.6 (14.4, 16.8)		12.7 (11.6, 13.9)		1.00		1.00	1.00
Healthcare coverage								
Yes	32.3 (31.4, 33.3)		21.9 (21.1, 22.7)		1.00		1.00	1.00

Characteristics	Fair/poor self-rated health		14 mentally unhealthy days		Fair/poor self-rated health		14 mentally unhealthy days	
	Unadjusted prev, % (95% CI)	Adjusted PR (95% CI)	Unadjusted prev, % (95% CI)	Adjusted PR (95% CI)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)
No	40.8 (37.1, 44.6)		32.1 (28.4, 36.0)		1.26 (1.15, 1.39)	1.09 (0.98, 1.22)	1.46 (1.29, 1.66)	1.07 (0.93, 1.23)
Physical activity								
Physically active	24.8 (23.8, 25.8)		19.2 (18.2, 20.2)		1.00	1.00	1.00	1.00
Physically inactive	51.5 (49.6, 53.3)		31.7 (29.9, 33.5)		2.08 (1.97, 2.19)	1.49 (1.40, 1.58)	1.65 (1.53, 1.79)	1.29 (1.19, 1.41)
Smoking status								
Never smoker	23.8 (22.7, 25.1)		16.6 (15.4, 17.7)		1.00	1.00	1.00	1.00
Past smoker	39.6 (37.8, 41.3)		21.9 (20.4, 23.4)		1.66 (1.55, 1.78)	1.15 (1.07, 1.23)	1.32 (1.20, 1.46)	1.13 (1.02, 1.25)
Current smoker	48.6 (46.4, 50.7)		40.0 (37.9, 42.2)		2.04 (1.91, 2.18)	1.21 (1.11, 1.31)	2.42 (2.21, 2.64)	1.34 (1.21, 1.48)
BMI								
Underweight	44.1 (36.3, 52.2)		31.0 (23.9, 39.1)		1.82 (1.50, 2.21)	1.45 (1.16, 1.80)	1.49 (1.15, 1.93)	1.26 (0.96, 1.67)
Normal weight	24.2 (22.6, 25.8)		20.8 (19.1, 22.6)		1.00	1.00	1.00	1.00
Overweight	28.7 (27.1, 30.4)		20.8 (19.3, 22.3)		1.19 (1.09, 1.30)	0.99 (0.91, 1.07)	1.00 (0.89, 1.12)	0.96 (0.86, 1.07)
Obese	42.5 (40.9, 44.1)		26.6 (25.1, 28.0)		1.76 (1.63, 1.90)	1.22 (1.13, 1.32)	1.28 (1.15, 1.41)	0.97 (0.88, 1.07)
Coexisting diseases ^b								
Yes	45.3 (44.2, 46.4)		26.9 (25.9, 27.9)		4.26 (3.76, 4.82)	2.28 (1.99, 2.63)	1.71 (1.54, 1.90)	1.33 (1.18, 1.51)
No	10.6 (9.4, 12.0)		15.7 (14.2, 17.3)		1.00	1.00	1.00	1.00
Depression								
Yes	48.6 (46.9, 50.3)		47.1 (45.4, 48.8)		1.97 (1.87, 2.08)	1.34 (1.26, 1.43)	4.63 (4.25, 5.05)	3.39 (3.06, 3.76)
No	24.7 (23.7, 25.7)		10.2 (9.4, 11.0)		1.00	1.00	1.00	1.00

Abbreviations: CI, confidence interval; Prev, prevalence; PR, prevalence ratio; NH, non-Hispanic

^a Adjusted logistic regression models constructed for each HRQoL indicator with all potential risk factors included in single model adjusting for all other risk factors in model (sex, race/ethnicity, age, income, health care coverage, physical activity, smoking, BMI, coexisting diseases, and depression). Unadjusted logistic regression models were constructed for each HRQoL indicator, each containing a single risk factor.

^b Coexisting diseases include heart disease, stroke, cancer, chronic obstructive pulmonary disease (COPD), arthritis, kidney disease, diabetes, and hypertension

Note: numbers in bold are statistically significantly associated with the reference category for each independent variable, determined by if the null value 1 is not within the 95% CI of PRs

Table 3

Factors associated with 14 physically unhealthy days and 14 days of activity limitation among adults with current asthma, 2015 Behavioral Risk Factor Surveillance System^a

Characteristics	14 physically unhealthy days		14 days of activity limitation		14 physically unhealthy days		14 days of activity limitation	
	Unadjusted prev, % (95% CI)	Adjusted prev, % (95% CI)	Unadjusted prev, % (95% CI)	Adjusted prev, % (95% CI)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)
Total	25.2 (24.4, 26.0)		18.8 (18.0, 19.5)					
Sex								
Male	22.7 (21.3, 24.1)		17.4 (16.2, 18.7)		1.00	1.00	1.00	1.00
Female	26.6 (25.6, 27.6)		19.5 (18.6, 20.4)		1.17 (1.09, 1.26)	1.03 (0.96, 1.12)	1.12 (1.03, 1.22)	0.97 (0.89, 1.07)
Race/ethnicity								
White NH	25.5 (24.6, 26.4)		18.8 (17.9, 19.6)		1.00	1.00	1.00	1.00
Black NH	23.4 (21.2, 25.7)		18.3 (16.2, 20.6)		0.92 (0.83, 1.02)	0.82 (0.72, 0.92)	0.98 (0.86, 1.11)	0.81 (0.70, 0.94)
American Indian/Alaskan Native NH	41.3 (35.3, 47.7)		29.7 (24.2, 35.9)		1.62 (1.39, 1.89)	1.14 (0.90, 1.44)	1.58 (1.29, 1.94)	0.94 (0.69, 1.29)
Asian NH	16.0 (10.2, 24.3)		10.8 (6.6, 17.3)		0.63 (0.41, 0.97)	1.17 (0.81, 1.69)	0.58 (0.35, 0.94)	1.17 (0.74, 1.84)
Other NH	32.5 (28.1, 37.1)		28.3 (24.0, 32.9)		1.27 (1.10, 1.47)	1.29 (1.12, 1.50)	1.51 (1.28, 1.77)	1.41 (1.19, 1.67)
Hispanic	23.7 (20.9, 26.6)		17.2 (14.9, 19.8)		0.93 (0.82, 1.05)	1.02 (0.89, 1.17)	0.92 (0.79, 1.07)	0.99 (0.84, 1.16)
Age, year range								
18–24	10.7 (8.8, 12.9)		8.1 (6.3, 10.2)		1.00	1.00	1.00	1.00
25–34	13.4 (11.9, 15.2)		12.0 (10.4, 13.8)		1.26 (1.00, 1.57)	1.13 (0.86, 1.50)	1.49 (1.12, 1.97)	1.16 (0.85, 1.58)
35–44	22.9 (20.9, 25.0)		18.2 (16.4, 20.2)		2.14 (1.74, 2.64)	1.57 (1.18, 2.07)	2.26 (1.74, 2.95)	1.45 (1.08, 1.93)
45–54	32.2 (30.2, 34.2)		25.8 (24.0, 27.7)		3.01 (2.47, 3.67)	1.80 (1.37, 2.36)	3.21 (2.49, 4.13)	1.63 (1.22, 2.17)
55–64	36.1 (34.2, 38.1)		26.7 (25.0, 28.6)		3.38 (2.78, 4.11)	1.77 (1.34, 2.32)	3.32 (2.58, 4.27)	1.51 (1.13, 2.01)
65	33.2 (31.4, 34.9)		20.1 (18.7, 21.5)		3.10 (2.55, 3.77)	1.67 (1.27, 2.20)	2.49 (1.93, 3.21)	1.26 (0.94, 1.69)
Annual household income								
<\$15 000	46.4 (43.9, 48.9)		38.3 (35.9, 40.7)		3.64 (3.30, 4.02)	2.40 (2.13, 2.70)	4.43 (3.91, 5.03)	2.54 (2.21, 2.93)
\$15 000–\$24 999	32.9 (30.7, 35.2)		26.7 (24.6, 28.9)		2.59 (2.32, 2.88)	1.99 (1.77, 2.23)	3.09 (2.70, 3.54)	2.18 (1.89, 2.52)
\$25 000–\$34 999	25.8 (23.2, 28.7)		16.9 (14.8, 19.3)		2.03 (1.77, 2.32)	1.64 (1.43, 1.88)	1.96 (1.65, 2.33)	1.38 (1.16, 1.65)
\$35 000–\$49 999	20.1 (17.8, 22.7)		13.0 (11.1, 15.1)		1.58 (1.37, 1.83)	1.39 (1.19, 1.61)	1.51 (1.25, 1.81)	1.30 (1.07, 1.57)
\$50 000	12.1 (11.7, 13.8)		8.6 (7.7, 9.6)		1.00	1.00	1.00	1.00
Healthcare coverage								
Yes	25.4 (24.6, 26.3)		18.7 (17.9, 19.4)		1.00	1.00	1.00	1.00

Characteristics	14 physically unhealthy days		14 days of activity limitation		14 physically unhealthy days		14 days of activity limitation	
	Unadjusted prev, % (95% CI)	Unadjusted prev, % (95% CI)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)
No	23.2 (20.4, 26.2)	19.5 (16.9, 22.5)	0.91 (0.80, 1.04)	0.81 (0.70, 0.93)	1.05 (0.90, 1.21)	0.89 (0.75, 1.05)		
Physical activity								
Physically active	18.5 (17.6, 19.5)	13.0 (12.2, 13.8)	1.00	1.00	1.00	1.00		
Physically inactive	41.0 (39.2, 42.7)	32.2 (30.5, 33.8)	2.21 (2.07, 2.36)	1.59 (1.48, 1.71)	2.47 (2.28, 2.68)	1.72 (1.58, 1.88)		
Smoking status								
Never smoker	17.7 (16.7, 18.7)	12.5 (11.6, 13.4)	1.00	1.00	1.00	1.00		
Past smoker	31.3 (29.7, 33.0)	22.2 (20.8, 23.7)	1.77 (1.64, 1.91)	1.19 (1.10, 1.29)	1.78 (1.62, 1.97)	1.18 (1.07, 1.30)		
Current smoker	37.4 (35.4, 39.4)	30.6 (28.7, 32.6)	2.11 (1.95, 2.29)	1.22 (1.11, 1.34)	2.46 (2.23, 2.71)	1.27 (1.14, 1.42)		
BMI								
Underweight	35.9 (28.7, 43.8)	26.4 (20.2, 33.8)	1.82 (1.46, 2.28)	1.43 (1.09, 1.88)	1.80 (1.37, 2.38)	1.36 (0.96, 1.93)		
Normal weight	19.7 (18.3, 21.3)	14.6 (13.3, 16.1)	1.00	1.00	1.00	1.00		
Overweight	22.1 (20.7, 23.6)	17.4 (16.0, 18.8)	1.12 (1.01, 1.24)	0.93 (0.84, 1.03)	1.19 (1.05, 1.34)	1.00 (0.88, 1.12)		
Obese	31.7 (30.3, 33.2)	23.0 (21.7, 24.3)	1.61 (1.47, 1.76)	1.07 (0.98, 1.18)	1.57 (1.40, 1.75)	1.01 (0.91, 1.13)		
Coexisting diseases ^b								
Yes	34.8 (33.7, 35.8)	26.1 (25.1, 27.1)	4.36 (3.84, 4.96)	2.01 (1.72, 2.36)	4.74 (4.00, 5.62)	2.22 (1.84, 2.67)		
No	8.0 (7.0, 9.0)	5.5 (4.7, 6.5)	1.00	1.00	1.00	1.00		
Depression								
Yes	39.1 (37.5, 40.7)	34.5 (33.0, 36.1)	2.20 (2.06, 2.35)	1.47 (1.37, 1.58)	3.30 (3.04, 3.58)	2.01 (1.83, 2.21)		
No	17.8 (16.9, 18.7)	10.4 (9.8, 11.2)	1.00	1.00	1.00	1.00		

Abbreviations: CI, confidence interval; Prev, prevalence; PR, prevalence ratio; NH, non-Hispanic

^a Adjusted logistic regression models constructed for each HRQoL indicator with all potential risk factors included in single model adjusting for all other risk factors in model (sex, race/ethnicity, age, income, health care coverage, physical activity, smoking, BMI, coexisting diseases, and depression). Unadjusted logistic regression models were constructed for each HRQoL indicator, each containing a single risk factor.

^b Coexisting diseases include heart disease, stroke, cancer, chronic obstructive pulmonary disease (COPD), arthritis, kidney disease, diabetes, and hypertension

Note: numbers in bold are statistically significantly associated with the reference category for each independent variable, determined by if the null value 1 is not within the 95% CI of PRs