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## Health-Related Quality of Life and Asthma among United States Adolescents

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### Abstract

**Objective**—To examine the direction and the magnitude of associations between asthma and health-related quality of life (HRQoL) in a population-based sample of US adolescents.

**Study design**—We obtained data from the 2001–2010 cross-sectional National Health and Nutrition Examination Survey. We used multinomial logistic regression and negative binomial regression to estimate corresponding percentages, prevalence ratios (PRs), and predicted days of 4 domains of HRQoL by 3 asthma status categories: never having asthma, having asthma without symptoms, and having asthma with symptoms.

**Results**—Compared with those who never had asthma, adolescents with asthma with symptoms of dry cough or wheezing reported significantly worse self-rated health (13.58% [95% CI, 10.32%–17.67%] vs 7.54% [95% CI, 6.50%–8.72%] for fair or poor health), significantly impaired physical health (PR = 1.34,  $P = .004$ ; adjusted physically unhealthy days, 2.7 days vs 2 days), and impaired mental health (PR = 1.26,  $P = .025$ ). Among adolescents having asthma with symptoms, those who currently smoked reported 1 more physically unhealthy day and 2.4 more mentally unhealthy days than those who did not smoke and did not have asthma. Those reporting limited physical functioning reported 2 more physically unhealthy days and 1.5 more mentally unhealthy days than those who did not report limited functioning.

**Conclusion**—Adolescents with asthma and symptoms reported worse HRQoL compared with those with asthma not reporting symptoms and those without asthma. Those who smoked or reported limited physical functioning reported worse physical and mental HRQoL. Reducing symptoms, quitting smoking, and improving physical functioning may improve HRQoL among adolescents with asthma.

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Asthma is a leading chronic illness among adolescents. In 2011, an estimated 4 million US adolescents (17.2%) aged 12–17 years reported ever having asthma, and approximately 2.7

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million (10.9%) reported currently having asthma.<sup>1</sup> Asthma is also a significant cause of morbidity and mortality, and is the leading cause of school absence among this age group.<sup>2</sup> The incremental total annual direct medical expenditures (eg, doctor/hospital visits and medicine) for pediatric asthma in the US total an estimated \$6.39 billion (in 2007 dollars).<sup>3</sup> The US Healthy People 2020 process has identified several important decennial objectives for adolescents with asthma, including reducing asthma-related deaths.<sup>4</sup>

Asthma is a chronic, reversible inflammatory disorder of the airways of the lungs.<sup>5</sup> It reduces adolescents' physical health<sup>6–8</sup> (eg, obesity, physical limitations), psychological health<sup>9</sup> (eg, anxiety, depression, self-esteem), and social health<sup>10</sup> (eg, social interaction, peer acceptance). It also adversely affects their health-related quality of life (HRQoL),<sup>11–18</sup> defined as an individual's or group's perceived physical or mental health over time.<sup>19–21</sup> The National Asthma Education and Prevention Program Expert Panel recommends evaluating quality of life as part of routine assessment and monitoring for asthma among adolescents.<sup>5</sup> Compared with adolescents without asthma, adolescents with asthma report worse physical and mental HRQoL,<sup>12,15,22</sup> especially the latter.<sup>23</sup> Adolescents with poor control of asthma symptoms also exhibit concurrent psychological distress and thus experience poorer emotional well being and mental health.<sup>9,12,17,24</sup> However, The relationship between HRQoL and asthma in adolescents has not been well examined in the general population.

Much of the current research on HRQoL in individuals with asthma has focused on adults,<sup>25–27</sup> and many previous studies of adolescent HRQoL used clinical samples with limited generalizability. Our study overcomes these limitations by using a large, nationally representative US adolescent sample over a period of 10 years. Findings from our study may be useful as baseline data for the Healthy People 2020 objectives related to adolescent HRQoL and asthma.

The objective of the present study was to examine the direction and magnitude of associations among 3 asthma categories (never having asthma, having asthma without symptoms, and having asthma with symptoms) and 4 generic Centers for Disease Control and Prevention (CDC) HRQoL measures (self-rated health, physically unhealthy days, mentally unhealthy days, and activity limitation days)<sup>17,18</sup> among US adolescents (aged 12–17 years) in a nationally representative sample, the National Health and Nutrition Examination Survey (NHANES).<sup>28</sup>

## Methods

We used data from the 2001–2010 NHANES, a nationally representative, multistage, cross-sectional survey designed to study the health and the nutritional status of the noninstitutionalized US civilian population.<sup>24</sup> The NHANES includes a household interview and a health examination component. The health examination component includes an additional interview, a physical examination, and laboratory tests conducted at a mobile examination center (MEC). The NHANES protocol and administration was approved by the National Center for Health Statistics Research Ethics Review Board. Adolescents were eligible for survey participation if their parents or guardians provided written consent and if

the adolescents themselves also signed a separate assent form.<sup>24</sup> Our final analysis sample included 7063 adolescents who answered questions about their HRQoL and asthma status during the additional interview at a NHANES MEC (<0.5% of adolescents, those who were cognitively impaired, used a proxy during the interview).

The HRQoL outcome measures in our study include self-rated health, physically unhealthy days, mentally unhealthy days, and activity limitation days.<sup>17</sup> The self-rated health measure came from responses to the question, “Would you say that in general your health is: (1) excellent; (2) very good; (3) good; (4) fair; or (5) poor?” We grouped these responses into 3 categories: fair or poor health, good health, and very good or excellent health. The physically unhealthy days measure came from responses to the question, “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?” The mentally unhealthy days measure came from responses to the question, “Now thinking about your mental health, which includes stress, depression, and problems with emotions, for about how many days during the past 30 days was your mental health not good?” The activity limitation days measure came from responses to the question, “Are you limited in any way in any activities because of physical, mental, or emotional problems?” Responses for these 3 “unhealthy days” measures range from 0 to 30 days.

Our main independent variable was asthma status classified as 3 mutually exclusive categories, never having asthma, having asthma without symptoms, and having asthma with symptoms. These categories were based on 4 questions: (1) “Has a doctor or other health professional ever told you that you have asthma?”; (2) “Do you still have asthma?”; (3) “In the past 12 months, have you had wheezing or whistling in your chest?”; and (4) “[In the past 12 months], have you had a dry cough at night not counting a cough associated with a cold or chest infection lasting 14 days or more?” Adolescents were classified as never having asthma if they answered no to the first question; as having asthma without symptoms if they answered yes to the first question but no to the second, third, and fourth questions; and as having asthma with symptoms if they answered yes to the first and second questions and yes to either the third or fourth question. These classifications are consistent with the CDC’s recommended case definitions for national asthma surveillance data.

Certain demographic characteristics and risk behaviors affect the association between asthma and HRQoL, and we adjusted for these as potential confounders.<sup>11,25,27,29</sup> Specifically, the demographic characteristics that we adjusted for include sex (boys or girls), race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, or other race), age (12–14 years or 15–17 years), and family poverty–income ratio (PIR: <130%, low income; >130%–350%, middle income; >350%, high income). We also adjusted for the risk behaviors of cigarette smoking (never smoker, former smoker, or current smoker) and leisure-time physical inactivity (physically inactive or physically active).

We also controlled for body mass index (BMI),<sup>25,26</sup> based on measured height and weight, and classified adolescents into 4 categories by calculating the BMI percentiles and z-scores for each adolescent NHANES participant based on the sex-specific reference population from the CDC’s 2000 BMI-for-age growth charts (obese: >95th percentile; overweight: 85th

to <95th percentile; normal weight: 5th to <85th percentile; underweight: <5th percentile). Other variables adjusted including health insurance coverage (yes or no) and limited physical functioning (yes or no),<sup>27,30–32</sup> determined by respondents' responses to a question asking if they have an impairment or health problem limiting the ability to crawl, walk, play, or run. Because changes in survey design and sampling during each survey cycle might affect the association between asthma and HRQoL, we also controlled for NHANES survey cycle interview years (2001–2002, 2003–2004, 2005–2006, 2007–2008, and 2009–2010).

### Statistical Analyses

For descriptive statistics, we calculated weighted percentages and their 95% CIs by asthma status at each level of the demographic characteristics, physical activity, BMI, health insurance coverage, cigarette smoking status, and physical functioning (Table I). We considered the point estimates of these percentages for these asthma categories as statistically significantly different when their 95% CIs did not overlap.<sup>33</sup>

We performed multinomial logistic regression to obtain both unadjusted and adjusted percentages (ie, predicted marginal proportions) of self-rated health for each asthma category in SAS-callable SUDAAN (Table II) (SAS Institute, Cary, North Carolina).<sup>34</sup> To model the 3 “unhealthy days” measures, we used Stata negative binomial regression procedure (Stata version 11; StataCorp, College Station, Texas) to obtain both the unadjusted and adjusted prevalence ratios (PRs) between never asthma (reference group) and the other 2 asthma categories and predicted marginal counts for each asthma category (Table III). We used a model-building approach to examine the changes in the main effect of asthma status on HRQoL outcomes. Specifically, in the base model (model 1), we obtained unadjusted estimates for each asthma category. In the reduced model (model 2), we obtained estimates for each asthma status category adjusting for demographic characteristics (sex, race/ethnicity, and age), interview year, physical inactivity, BMI, and health insurance coverage. In the full model (model 3), we added family PIR, cigarette smoking status, and limited physical functioning. Because further analyses suggested that cigarette smoking status and limited physical functioning significantly moderated the associations between asthma status and physically and mentally unhealthy days, we examined their interactions with asthma status on physically and mentally unhealthy days (Table IV). In all of these analyses, we accounted for the respondent sample MEC weights, the strata, and the primary sampling units of the NHANES' complex sample survey design.

### Results

Overall, approximately 6.2% of adolescents reported having asthma without symptoms, and 12.4% reported having asthma with symptoms (results not shown). The percentages of some levels of demographic characteristics and risky behaviors were similar across asthma status categories—sex, interview year, physical activity, and PIR (Table I). Compared with adolescents who never had asthma, however, those who had asthma without symptoms were older (59.0% vs 49.4% aged 15–17 years) and more often a current smoker (18.1% vs 10.2%; Table I). Compared with those who never had asthma, those who had asthma with symptoms were more likely to be black, non-Hispanic (19.1% vs 14.0%), more likely to

have insurance (92.1% vs 87.8%), more often obese (25.3% vs 16.8%), and almost 8 times more likely to report having limited physical functioning (23.1% vs 3.1%; Table I).

### Self-Rated Health

Overall, adolescents with asthma and symptoms reported significantly worse self-rated health compared with adolescents who never had asthma. Significantly fewer adolescents with asthma and symptoms than those who never had asthma reported excellent or very good health before adjustment (49.37% vs 58.59%; model 1; Table II). Adjusting for some demographic characteristics (sex, race/ethnicity, and age), physical inactivity, BMI, and insurance did not change this result (51.07% vs 58.57%; model 2; Table II). However, the percentage reporting excellent or very good health was no longer significantly different between the 2 groups after adjustment for family PIR, smoking status, and limited physical functioning (model 3). Significantly more adolescents with asthma with symptoms than those who never had asthma reported fair or poor health, both with adjustment (13.58% vs 7.54%; model 3) and without adjustment (16.62% vs 7.58%; model 1). Adolescents with asthma but without symptoms had similar self-rated health measures as those who never had asthma (Table II).

### Physically Unhealthy Days

Overall, adolescents with asthma and symptoms reported a significantly higher mean number of physically unhealthy days (mean, 2.75 days, PR = 1.36;  $P = .002$ , model 1) compared with those who never had asthma (mean, 2.02 days; model 1; Table III). Adjusting for differences in demographic characteristics (ie, sex, race/ethnicity, and age), interview year, physical inactivity, BMI, and insurance did not change this association (adjusted predicted days, 2.71 vs 2.02; PR = 1.34;  $P = .004$ ; model 2; Table III); however, this difference became nonsignificant after adjustment for family PIR, smoking status, and limited physical functioning (model 3; Table III). Adjusted mean physically unhealthy days did not differ between adolescents without asthma and those with asthma but without symptoms (Table III).

The interactions between adolescents' smoking status and limited physical functioning (ie, crawl, walk, run, and play limitations) and asthma status were significantly associated with physically unhealthy days even after adjusting for all covariates. For example, adolescents with asthma and symptoms who currently smoked (predicted days, 3.06) reported approximately 1 more physically unhealthy day than those who never had asthma and never smoked (adjusted predicted days, 1.95) (Table IV). Adolescents with asthma and symptoms who had limited physical functioning (adjusted predicted days, 4.47) reported approximately 2.5 more physically unhealthy days than those who never had asthma and did not have limited physical functioning (adjusted predicted days, 1.95) (Table IV).

### Mentally Unhealthy Days

In general, compared with adolescents who never had asthma, adolescents with asthma and symptoms reported a significantly higher prevalence rate (unadjusted: PR = 1.31;  $P = .008$  [model 1]; adjusted: PR = 1.26;  $P = .025$  [model 2]), but not more predicted mentally unhealthy days (Table III). However, after adjustment for family PIR, smoking status, and

limited physical functioning, the difference between the 2 groups was no longer significant (model 3). The differences in prevalence rate and predicted number of mentally unhealthy days were not significant between those without asthma and those with asthma and no symptoms.

Similar to physically unhealthy days, the interactions of adolescents' smoking status and limited physical functioning with asthma status was significantly associated with mentally unhealthy days. Specifically, adolescents who either formerly smoked or currently smoked within each asthma category reported significantly more mentally unhealthy days than those who never had asthma and never smoked (4.84 days for asthma with symptoms and current smoker vs 2.43 days for never asthma and never smoker; Table IV). Those with asthma and symptoms who had limited physical functioning (adjusted predicted days, 4.59) also reported 2 more mentally unhealthy days than those who never had asthma or any limited physical functioning (adjusted predicted days, 2.69; Table IV).

### Activity Limitation Days

The prevalence rate and predicted number of activity limitation days were not statistically significantly different among the asthma status categories either before or after adjustment for covariates (Table III).

## Discussion

Pediatricians, clinicians, and other public health researchers have recognized the importance of assessing HRQoL as part of the routine diagnosis and management of asthma in children and adolescents.<sup>5</sup> Studies examining how asthma affects adolescents' HRQoL provide useful information for asthma control and treatment in this age group.<sup>13,14,35</sup> Consistent with previous studies, we found that asthma is adversely associated with almost all domains of HRQoL, but only adolescents who currently had asthma symptoms reported worse HRQoL. Specifically, compared with those who never had asthma, adolescents with asthma and symptoms reported significantly less excellent or very good health, more fair or poor health, a higher prevalence of, and more average days of physically unhealthy days, and a higher prevalence of mentally unhealthy days (although this last effect disappeared after adjusting for smoking and limited physical functioning). Adolescents with asthma but without symptoms did not report significantly worse HRQoL than adolescents who never had asthma.

One possible explanation for our findings is that youths with asthma are often bothered by or even frustrated over persistent symptoms such as shortness of breath, wheezing, and cough, and thus might be at higher risk of developing depression and anxiety, which might contribute to their impaired HRQoL.<sup>16</sup> This observation is also consistent with previous research that shows that the prevalence of depression and anxiety is significantly higher among children with asthma compared with the general population.<sup>9,24</sup> Help with controlling asthma symptoms from pediatricians and other health professionals also might improve these adolescents' HRQoL.

In addition, our findings suggest that adolescents' smoking status and limited physical functioning (limitations in walking, playing, or running) might moderate the association between asthma and physical/mental health. Specifically, adolescents with asthma and symptoms who smoked reported far worse HRQoL, especially mental HRQoL. For example, among those with asthma, adolescents who formerly smoked or currently smoked reported approximately 2 more mentally unhealthy days than those who never smoked. Adolescents with asthma might be more likely to smoke because they might feel depressed or have low self-efficacy because of asthma symptoms.<sup>36</sup> Conversely, smoking might increase adolescents' risk of asthma onset<sup>37</sup> or further worsen their asthma symptoms, in turn affecting their reported mental health.<sup>38</sup> Therefore, given the higher prevalence of smoking in adolescents with asthma in the present study, pediatricians and other health professionals should encourage adolescents with asthma to quit smoking to improve their mental as well as physical health.

Among adolescents with asthma and symptoms, those with limited physical functioning also reported significantly more physically and mentally unhealthy days compared with those without physical limitations. The effect of limited physical functioning on the physical health of adolescents with asthma and symptoms is noteworthy. Previous research has shown that adolescents with asthma might suffer from impaired HRQoL owing to changes in physical health,<sup>29,39</sup> but the underlying mechanism of this effect might be more complicated, possibly mediated or moderated through other associated risk factors (eg, disability). Although a cause-and-effect relationship cannot be established based on the present cross-sectional study, asthma symptoms might disrupt adolescents' normal physical functioning and in turn worsen their reported HRQoL. Given that 1 in 5 adolescents with asthma and symptoms in our series reported limited physical functioning, pediatricians and other health professionals might want to focus on both controlling for asthma symptoms and improving physical functioning to improve their patients' overall physical health.

Our study has several limitations. First, NHANES HRQoL data are self-reported and are not corroborated by others (eg, parents), making them subject to misclassification. However, most adolescents understand and are able to provide reliable answers to the CDC's HRQoL questions (Research Support Services I, unpublished data, 2001). Second, our classifications of asthma status are based on an asthma case definition for surveillance and might not be fully compatible with clinical case definitions that often can be validated by spirometry or other clinical laboratory tests; however, these definitions have been used in other large national surveillance systems, including the Behavioral Risk Factor Surveillance System and the National Health Interview Survey, since 2001, as well as for research in this area.<sup>27</sup> Third, compared with disease-specific asthma HRQoL scales, our 4-item HRQoL measures may not be sufficiently sensitive to detect responses to treatment and monitor adequate control of asthma symptoms. Finally, because the NHANES is cross-sectional, the associations that we observed might not be causal and might have resulted from other potential confounders that we did not adjust for. In adult HRQoL research, for example, asthma often co-occurs with other comorbidities, such as diabetes mellitus, which in turn also affects HRQoL.<sup>39</sup> However, adolescents are relatively healthy, and the prevalence of such comorbidities among adolescents is too low to affect our findings (analysis not shown).

Despite these study limitations, the adolescents with asthma and symptoms in our series reported significantly impaired HRQoL. Given that smoking and limited physical functioning may affect the association between asthma and HRQoL, an approach involving reducing symptoms, quitting smoking, and improving physical functioning may improve HRQoL in adolescents with asthma.

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## Glossary

<b>BMI</b>	Body mass index
<b>CDC</b>	Centers for Disease Control and Prevention
<b>HRQoL</b>	Health-related quality of life
<b>MEC</b>	Mobile examination center
<b>NHANES</b>	National Health and Nutrition Examination Survey
<b>PIR</b>	Poverty–income ratio
<b>PR</b>	Prevalence ratio

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Number and weighted percentage of US adolescents in each asthma status for selected demographic variables and risk behaviors, NHANES, 2001–2010

Table 1

Variables	Never asthma			Asthma without symptoms			Asthma with symptoms		
	n	Weighted, % (95% CI)	n	Weighted, % (95% CI)	n	Weighted, % (95% CI)	n	Weighted, % (95% CI)	
Sex									
Boys	2877	50.1 (48.4–51.8)	228	52.9 (45.9–59.8)	477	50.7 (46.9–54.5)			
Girls	2907	49.9 (48.2–51.6)	177	47.1 (40.2–54.1)	413	49.3 (45.5–53.1)			
Age, y									
12–14	2888	50.6 (48.8–52.4)	184	41.0 (34.5–47.9)	446	49.8 (45.3–54.2)			
15–17	2896	49.4 (47.6–51.2)	221	59.0 (52.1–65.5)*	444	50.2 (45.8–54.7)			
Race/ethnicity									
White, non-Hispanic	1654	61.7 (58.2–65.0)	126	63.9 (56.9–70.4)	250	59.0 (53.7–64.1)			
Black, non-Hispanic	1715	14.0 (12.2–15.9)	131	12.7 (9.5–16.8)	342	19.1 (15.9–22.7)*			
Mexican American	1829	12.6 (10.7–14.8)	95	9.0 (6.5–12.4)	190	8.7 (6.9–10.9)			
Other	586	11.8 (9.9–14.0)	53	14.4 (10.2–20.0)	108	13.2 (9.9–17.4)			
Interview year									
2001–2002	1520	20.3 (18.1–22.7)	109	15.8 (11.7–21.1)	213	19.2 (15.5–23.6)			
2003–2004	1354	19.5 (16.9–22.3)	96	21.0 (15.4–28.0)	222	19.5 (16.3–23.2)			
2005–2006	1340	19.9 (17.3–22.8)	90	20.5 (15.0–27.2)	199	21.0 (16.9–25.8)			
2007–2008	750	19.5 (17.4–21.9)	57	25.5 (18.4–34.2)	125	21.1 (17.6–25.1)			
2009–2010	820	20.8 (18.4–23.5)	53	17.2 (12.6–23.0)	131	19.2 (15.7–23.2)			
Physical activity									
Physically active	4744	88.0 (86.7–89.2)	333	89.6 (84.8–93.0)	739	89.2 (86.8–91.2)			
Physically inactive	735	12.0 (10.8–13.3)	44	10.4 (7.0–15.2)	98	10.8 (8.8–13.2)			
BMI									
Underweight	233	4.4 (3.7–5.2)	20	5.2 (2.9–9.0)	40	4.8 (3.1–7.4)			
Normal weight	3500	63.0 (61.2–64.8)	240	64.4 (57.2–71.1)	458	52.9 (48.6–57.2)*			
Overweight	929	15.8 (14.5–17.1)	74	15.6 (11.0–21.6)	161	17.0 (14.6–19.7)			
Obese	1122	16.8 (15.3–18.4)	71	14.8 (10.6–20.2)	231	25.3 (21.3–29.8)*			
Insurance									
Yes	4724	87.8 (86.1–89.4)	358	92.0 (88.0–94.8)	792	92.1 (89.4–94.1)			

Variables	Never asthma		Asthma without symptoms		Asthma with symptoms	
	n	Weighted, % (95% CI)	n	Weighted, % (95% CI)	n	Weighted, % (95% CI)
No	1005	12.2 (10.6–13.9)	42	8.0 (5.2–12.0)	89	7.9 (5.9–10.6)*
PIR						
Low-income family	2150	28.0 (25.8–30.3)	132	22.2 (17.3–28.0)	334	30.1 (25.7–34.8)
Middle-income family	2071	37.0 (34.7–39.5)	152	39.9 (31.7–48.7)	305	36.8 (31.9–41.9)
High-income family	1199	34.9 (32.1–37.9)	104	37.9 (29.3–47.4)	198	33.2 (28.1–38.6)
Smoking status						
Never smoker	4285	81.5 (79.7–83.2)	291	74.4 (65.7–81.5)	651	78.5 (74.7–81.9)
Past smoker	489	8.3 (7.5–9.3)	31	7.5 (4.9–11.5)	65	9.1 (6.8–12.1)
Current smoker	475	10.2 (9.0–11.5)	44	18.1 (12.2–26.0)*	95	12.4 (10.0–15.2)
Crawl, walk, run, play limitations						
Yes	184	3.1 (2.6–3.8)	16	3.4 (1.9–6.2)	189	23.1 (19.1–27.6)*
No	5598	96.9 (96.2–97.4)	389	96.6 (93.8–98.1)	701	76.9 (72.4–80.9)*

\*  $P < .05$  compared with adolescents who reported never having asthma.

**Table II**

Unadjusted and adjusted percentages of self-rated health measures among adolescents by asthma status, NHANES, 2001–2010

Asthma status category	n	Self-rated health		
		Excellent/very good, % (95% CI)	Good, % (95% CI)	Fair/poor, % (95% CI)
Model 1 <sup>*</sup>				
Never asthma	5361	58.59 (56.59–60.57)	33.82 (32.01–35.68)	7.58 (6.53–8.79)
Asthma without symptoms	371	60.02 (52.34–67.24)	32.43 (25.83–39.81)	7.55 (4.33–12.85)
Asthma with symptoms	823	49.37 (43.78–54.97)	34.01 (29.20–39.17)	16.62 (13.16–20.77)
Model 2 <sup>†</sup>				
Never asthma	5301	58.57 (56.57–60.55)	33.82 (32.02–35.66)	7.61 (6.55–8.82)
Asthma without symptoms	367	58.07 (50.49–65.30)	33.40 (26.54–41.04)	8.53 (5.02–14.14)
Asthma with symptoms	812	51.07 (45.62–56.49)	33.66 (28.91–38.77)	15.27 (11.90–19.38)
Model 3 <sup>‡</sup>				
Never asthma	4922	58.89 (56.93–60.82)	33.57 (31.78–35.41)	7.54 (6.50–8.72)
Asthma without symptoms	352	58.28 (50.56–65.61)	33.71 (26.93–41.23)	8.01 (4.37–14.24)
Asthma with symptoms	762	52.96 (47.38–58.46)	33.46 (28.59–38.71)	13.58 (10.32–17.67)

\* Model 1: unadjusted model.

† Model 2: adjusted for demographic characteristics (sex, race/ethnicity, and age), interview year, physical inactivity, BMI, and insurance.

‡ Model 3: adjusted for demographic characteristics (sex, race/ethnicity, and age), interview year, physical inactivity, BMI, insurance, family PIR, smoking status, and limited physical functioning.

Unadjusted and adjusted PRs and predicted marginal unhealthy days among adolescents by asthma status, NHANES, 2001–2010

**Table III**

Asthma status category	PR (95% CI)			Predicted marginal unhealthy days (95% CI)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<b>Physically unhealthy days</b>						
Never asthma	1.00	1.00	1.00	2.02 (1.83–2.21)	2.02 (1.83–2.21)	2.06 (1.86–2.27)
Asthma without symptoms	1.19 (0.94–1.50)	1.17 (0.93–1.48)	1.17 (0.91–1.51)	2.40 (1.87–2.94)	2.37 (1.84–2.89)	2.41 (1.84–2.98)
Asthma with symptoms	1.36 (1.12–1.65)	1.34 (1.10–1.63)	1.12 (0.91–1.39)	2.75 (2.28–3.21)	2.71 (2.25–3.16)	2.32 (1.88–2.75)
n	6543	6472	6032	6543	6472	6032
<b>Mentally unhealthy days</b>						
Never asthma	1.00	1.00	1.00	2.76 (2.53–3.00)	2.80 (2.56–3.03)	2.79 (2.56–3.02)
Asthma without symptoms	1.23 (0.95–1.60)	1.11 (0.88–1.40)	1.09 (0.85–1.39)	3.40 (2.54–4.26)	3.09 (2.38–3.80)	3.03 (2.31–3.75)
Asthma with symptoms	1.31 (1.08–1.59)	1.26 (1.03–1.54)	1.08 (0.87–1.33)	3.61 (2.96–4.27)	3.53 (2.87–4.18)	3.00 (2.41–3.60)
n	6544	6473	6030	6544	6473	6030
<b>Activity limitation days</b>						
Never asthma	1.00	1.00	1.00	0.97 (0.82–1.13)	0.97 (0.82–1.13)	0.99 (0.82–1.16)
Asthma without symptoms	1.10 (0.80–1.51)	1.04 (0.78–1.39)	1.11 (0.81–1.51)	1.07 (0.79–1.35)	1.02 (0.77–1.26)	1.10 (0.82–1.37)
Asthma with symptoms	1.29 (0.91–1.82)	1.28 (0.94–1.75)	1.08 (0.79–1.47)	1.26 (0.91–1.60)	1.25 (0.93–1.57)	1.07 (0.80–1.34)
n	6543	6474	6032	6543	6474	6032

**Table IV**

Adjusted physically unhealthy days and mentally unhealthy days by categories of asthma status and smoking status and crawl, walk, run, and play limitations, NHANES, 2001–2010

	Physically unhealthy, predicted marginal unhealthy days (95% CI)	Mentally unhealthy, predicted marginal unhealthy days (95% CI)
Categories of asthma status and smoking status		
Never asthma and never smoker	1.95 (1.73–2.17)	2.43 (2.18–2.67)
Never asthma and past smoker	2.28 (1.68–2.88)	3.74 (3.05–4.44)
Never asthma and current smoker	2.73 (2.19–3.27)	4.49 (3.71–5.28)
Asthma without symptoms and never smoker	2.27 (1.72–2.83)	2.64 (2.00–3.28)
Asthma without symptoms and past smoker	2.66 (1.76–3.55)	4.07 (2.84–5.29)
Asthma without symptoms and current smoker	3.19 (2.28–4.10)	4.88 (3.48–6.29)
Asthma with symptoms and never smoker	2.18 (1.76–2.61)	2.61 (2.07–3.16)
Asthma with symptoms and past smoker	2.55 (1.81–3.29)	4.03 (2.93–5.12)
Asthma with symptoms and current smoker	3.06 (2.28–3.85)	4.84 (3.66–6.01)
Categories of asthma status and crawl, walk, run, play limitations		
Never asthma and not having limited physical functioning	1.95 (1.75–2.14)	2.69 (2.47–2.92)
Never asthma and having limited physical functioning	3.99 (2.87–5.10)	4.27 (3.11–5.42)
Asthma without symptoms and not having limited physical functioning	2.27 (1.74–2.80)	2.93 (2.23–3.63)
Asthma without symptoms and having limited physical functioning	4.66 (2.91–6.40)	4.63 (3.10–6.17)
Asthma with symptoms and not having limited physical functioning	2.18 (1.74–2.62)	2.90 (2.30–3.50)
Asthma with symptoms and having limited physical functioning	4.47 (3.31–5.63)	4.59 (3.30–5.88)

Model adjusted for demographic characteristics (sex, race/ethnicity, and age), interview year, physical inactivity, BMI, insurance, family PIR, smoking status, and limited physical functioning.