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

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**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. *(J Pediatr 2015;166:358-64)*.

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 million (10.9%) reported currently having asthma.[1] Asthma is also a significant cause of morbidity and mortality, and is the leading cause of school absence among this age group.[2] 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).[3] The US Healthy People 2020 process has identified several important decennial objectives for adolescents with asthma, including reducing asthma-related deaths.[4]

Asthma is a chronic, reversible inflammatory disorder of the airways of the lungs.[5] It reduces adolescents' physical health[6-8] (eg, obesity, physical limitations), psychological health[9] (eg, anxiety, depression, self-esteem), and social health[10] (eg, social interaction, peer acceptance). It also adversely affects their health-related quality of life (HRQoL),[11-18] defined as an individual's or group's perceived physical or mental health over time.[19-21] 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.[5] Compared with adolescents without asthma, adolescents with asthma report worse physical and mental HRQoL,[12,15,22] especially the latter.[23] Adolescents with poor control of asthma symptoms also exhibit concurrent psychological distress and thus experience poorer emotional well being and mental health.[9,12,17,24] 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,[25-27] 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.

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

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W.C. was supported in part by an appointment to the Research Participation Fellowship Program for the Centers for Disease Control and Prevention (CDC), administered by the Oak Ridge Institute for Science and Education (ORISE) through an agreement between the CDC and ORISE. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention. The authors declare no conflicts of interest.

0022-3476/$ - see front matter. Published by Elsevier Inc.
http://dx.doi.org/10.1016/j.jpeds.2014.10.005

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)[17,18] among US adolescents (aged 12-17 years) in a nationally representative sample, the National Health and Nutrition Examination Survey (NHANES).[28]

## 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.[24] 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.[24] 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.[17] 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.[11,25,27,29] 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),[25,26] 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),[27,30-32] 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.[33]

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