Original Article

National Prevalence of Poor Asthma Control and Associated Outcomes among School-Aged Children in the United States

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What is already known about this topic? Poor control is a common problem among children in the United States.

What does this article add to our knowledge? This article characterizes the trends in poor control and treatment among a nationally representative sample of children in the United States.

How does this study impact current management guidelines? This study shows that poor control is prevalent and daily controller use is infrequent. Renewed and vigilant asthma management is necessary to mitigate the current and long-term public health effects associated with poor asthma control.

BACKGROUND: The degree of asthma control among school-aged children (SAC) nationally is not well understood.
OBJECTIVE: The objective of this study was to characterize poor control among SAC (aged 6-17 years) in the United States.
METHODS: This was a retrospective analysis of the 2007-2013 Medical Expenditure Panel Survey. Indicators of poor control included exacerbation in previous year; use of >3 canisters of short-acting β-agonist (SABA) in 3 months; and asthma-specific (AS) emergency department (ED) or inpatient (IP) visits.

Treatment indicators included daily controller medication and peak flow meter use. Negative binomial regression was used for health resource utilization (HRU); generalized linear models with log-link were used for health care expenditures.
RESULTS: There were 44,320 SAC, of whom 5,890 had asthma. The prevalence of poor control and treatment among SAC with asthma were as follows: exacerbation (59%), >3 canisters of SABA (4%), ED/IP visit (3%), daily controller (19%), peak flow (12%). In 2013, 3.4 million SAC had an asthma exacerbation and 200,000 had an AS ED/IP visit. SAC with asthma and an exacerbation had 18.9 times more annual AS ED visits (and 43.3 times more AS hospitalizations) than SAC with asthma but no exacerbation. SAC with asthma and an indicator of poor control incurred greater annual all-cause expenditures than SAC without asthma ($US 2015): $1,144 (exacerbation), $1,859 (≥3 canisters of SABA), and $3,063 (ED/IP visit). Use of daily controller medication was low even among SAC with poor control (27% to 61%).
CONCLUSION: Renewed and vigilant asthma management and treatment is necessary to mitigate the current and long-term public health effects and expenditures associated with poor asthma control.   © 2017 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2017;■:■-■)

Key words: Asthma control; Children; Asthma; Health resource utilization; Expenditures

Asthma is the most common chronic condition among school-aged children (SAC). An estimated 6.2 million children under 18 years of age have asthma, and the prevalence has increased by 28% from 2000 to 2011.[1] In 2015, asthma prevalence among SAC in the United States ranged from 5.8% to 12.1%, depending on the state.[2] Poorly controlled asthma leading to acute events among SAC is a concern. Approximately 3.1 million children experienced an asthma attack or episode in 2015.[2] Asthma is the third leading cause of hospitalization among

Abbreviations used
   AC- All-cause
  ACQ- Asthma Control Questionnaire
   AS- Asthma-specific
   ED- Emergency department
   HC- Household Component
  HRU- Health resource utilization
ICD-9- International Classification of Diseases, Ninth Revision
  MCS- Mental Component Score
MEPS- Medical Expenditure Panel Survey
  MPC- Medical Provider Component
  NCC- Number of chronic conditions
  NHIS- National Health Interview Survey
  OCS- Oral corticosteroid
  PCS- Physical Component Score
SABA- Short-acting β-agonist
  SAC- School-aged children

children. Children under 15 made up 20% of the US population, but incurred 29% of all asthma-related discharges in 2015.[2] SAC with asthma have been shown to have greater health resource utilization (HRU) and expenditures than SAC without asthma in the United States.[3,4]

Asthma control is the goal of treatment. It is defined as the extent to which asthma therapy minimizes asthma symptoms and meets therapy goals.[5] It is composed of 2 domains: impairment (asthma-related symptoms and limitations experienced by the patient) and risk (the likelihood of future exacerbations and progressive loss of lung function).[5] There are several accepted methods of measuring asthma control, including the use of standardized asthma control instruments such as the Asthma Control Questionnaire (ACQ), the Asthma Therapy Assessment Questionnaire, or the Asthma Control Test.[6] However, standardized asthma control instruments are generally not available in large public health surveys. In the absence of standardized ACQs, one method that has been used in general population surveys is to measure proxies of impairment/symptoms and risk/exacerbations. Previous research has shown that short-acting β-agonist (SABA) use can be a proxy for symptom control; and hospitalizations, emergency department (ED) visits, and self-reported exacerbations are good proxies for risk.[7-11] Previous studies have characterized the national prevalence of these indicators of asthma control and associated outcomes in a nationally representative adult asthma sample. The authors found evidence of suboptimal asthma control with underuse of long-term control medications, overuse of quick-relief inhalers, and a significant number of self-reported asthma exacerbations among the general adult population in the United States. They also found that adults with indicators of poor asthma control had significantly more hospital and ED visits and incurred greater health care expenditures than those with asthma alone.[7,11]

A recent review of the state of asthma control among children in the United States emphasized the urgency of understanding both domains of impairment and risk among SAC because children with persistent asthma symptoms have an increased risk of exacerbations, hospitalizations, ED visits, and oral corticosteroid (OCS) use, with exacerbations leading to progressive loss of lung function that can last into adulthood.[12] Despite heightened awareness of the importance of achieving asthma control among SAC, the degree of asthma control among the

broader national population of SAC in the United States is not well understood. The objective of this study was to examine the prevalence of indicators of poor asthma control, treatment patterns, and associated outcomes in a nationally representative sample of SAC in the United States.

METHODS
Study design
This study was a retrospective analysis of cross-sectional data for SAC (aged 6-17 years) in the nationally representative 2007-2013 Medical Expenditure Panel Survey (MEPS). Indicators of poor asthma control included: (1) asthma exacerbation (self-reported); (2) use of >3 canisters of SABA in the previous 3 months (self-reported); or (3) asthma-specific (AS) ED visit or hospitalization (utilization based). Indicators of asthma treatment included: (1) use of daily asthma controller medication, including both oral medicine and inhalers (self-reported); and (2) any previous use of a peak flow meter (self-reported). The indicators of poor control and treatment were chosen based on what was available in the MEPS. The primary objective of this study was descriptive: to characterize the national prevalence of indicators of poor asthma control and treatment among SAC with asthma. The secondary objective was to examine differences in outcomes. HRU and health care expenditures of SAC with asthma and an indicator of poor asthma control were compared with SAC with asthma but no indicator of poor control and with SAC without asthma. The hypothesis was that HRU and expenditures are higher for SAC with asthma and an indicator of poor control.

Data source
MEPS is a nationally representative survey of the US civilian noninstitutionalized population that incorporates survey data from patients and families, medical providers, insurance providers, and employers to provide a comprehensive portrait of medical resource utilization, the frequency of utilization, costs of provided services, how these costs are paid, and the extent and scope of health insurance coverage for US residents. It is an overlapping panel design that includes 5 rounds of interviews in which each cohort is followed for 2 years. Respondents complete the battery of questions in each round with 3 rounds per year. The MEPS Household Component (HC) contains detailed self-reported information on demographic and socioeconomic characteristics, health conditions, insurance status, smoking status, and utilization and cost of health care services. In addition, MEPS treats asthma as a priority condition and contains several questions specific to asthma. MEPS collects data on annual utilization and expenditures of office- and hospital-based care, home health care, dental services, vision aids, and prescribed medicines. The MEPS Medical Provider Component (MPC) is a follow-back survey that collects detailed information from a sample of pharmacies and health care providers used by MEPS respondents. The MPC supplements and validates information on medical utilization, pharmacy events, and expenditures.

Each annual MEPS HC sample size is approximately 15,000 households. Data must be weighted to produce national estimates. The set of households selected for each panel of the MEPS HC is a subsample of households participating in the previous year's National Health Interview Survey (NHIS) conducted by the National Center for Health Statistics, which is part of the Centers for Disease Control and Prevention. The NHIS sampling frame provides a nationally representative sample of the US civilian noninstitutionalized population and reflects an oversample of blacks, Hispanics, and Asians. For over 50 years, the US Census Bureau has been the