

Exercise-induced bronchospasm in children with asthma in the United States: Results from the Exercise-Induced Bronchospasm Landmark Survey

Nancy K. Ostrom, M.D.,¹ Nemr S. Eid, M.D.,² Timothy J. Craig, D.O.,³ Gene L. Colice, M.D.,⁴ Mary Lou Hayden, N.P., A.E.-C.,⁵ Jonathan P. Parsons, M.D.,⁶ and Stuart W. Stoloff, M.D.⁷

ABSTRACT

Despite the availability of effective therapies, uncontrolled asthma remains a common problem. Previous large surveys suggest that exercise-related respiratory symptoms may be a significant element of uncontrolled asthma. The Exercise-Induced Bronchospasm (EIB) Landmark Survey is the first comprehensive, national survey evaluating EIB awareness and impact among the general public, asthma patients, and health care providers. This study was designed to evaluate the prevalence and impact of exercise-related respiratory symptoms in children (aged 4–17 years) with asthma. A national survey was conducted with parents of 516 children diagnosed with asthma or taking medications for asthma in the prior year. The majority of parents reported that their child experienced one or more exercise-related respiratory symptom and almost one-half (47.4%) experienced four or more symptoms. Most commonly reported symptoms were coughing, shortness of breath, and wheezing. Respondents reported that asthma limited their child's ability to participate either "a lot" or "some" in sports (30%), other outdoor activities (26.3%), and normal physical exertion (20.9%). Only 23.1% of children with exercise-related respiratory symptoms were reported to take short-acting beta-agonists such as albuterol "always" or "most of the time" before exercising. Exercise-related respiratory symptoms among pediatric asthma patients are common and substantially limit the ability of children to participate normally and perform optimally in physical activities. Such symptoms may reflect uncontrolled underlying asthma that should be evaluated and treated with appropriate controller medications. Despite the availability of preventative therapy, many children do not use short-acting bronchodilators before exercise as recommended in national guidelines.

(Allergy Asthma Proc 32:425–430, 2011; doi: 10.2500/aap.2011.32.3502)

Asthma is the most common chronic illness in adolescents and children, affecting an estimated 7 million children (9%) in the United States.¹ Despite the availability of effective therapies, uncontrolled asthma remains a very common problem; one survey con-

ducted in 2429 pediatric patients with asthma found that the prevalence of uncontrolled asthma was as high as 46%.² Uncontrolled asthma is associated with a significant disease burden and is the most common reason for missed school days in children.³ Several factors, including nonadherence to therapy and lack of effective asthma education, have been shown to contribute to poor asthma control.⁴ The Asthma in America (AIM) survey⁵ found that approximately one-half (49%) of patients with asthma surveyed fit the National Asthma Education and Prevention Program guideline definitions of poorly controlled asthma. Recent large surveys such as AIM and Comprehensive Survey of Healthcare Professionals and Asthma Patients Offering Insight on Current Treatment Gaps and Emerging Device Options (CHOICE) suggest that exercise-related respiratory symptoms may be a significant element of uncontrolled asthma.

The AIM survey further found that twice as many adults with asthma reported that their asthma limits them "a lot" or "some" in normal physical exertion (42%) compared with adults without asthma (21%). Similarly, in the CHOICE survey, more than one-half (56%) of adults and adolescents (aged ≥12 years) with asthma reported symptoms during exercise, play, or physical exertion in the prior 4 weeks, with nearly two

From the ¹Allergy and Asthma Medical Group and Research Center, San Diego, California, ²Department of Pediatric Pulmonology, University of Louisville, Louisville, Kentucky, ³Department of Allergy and Immunology, Pennsylvania State University, Hershey, Pennsylvania, ⁴Department of Pulmonary and Critical Care, Washington Hospital Center, Silver Spring, Maryland, ⁵Department of Asthma and Allergy, University of Virginia, Charlottesville, Virginia, ⁶Department of Pulmonary, Allergy, Critical Care, and Sleep Medicine, Ohio State University Asthma Center, Columbus, Ohio, and ⁷Department of Family and Community Medicine University of Nevada School of Medicine, Reno, Nevada

The EIB Landmark Survey was sponsored by Teva Respiratory, LLC

N Ostrom received grant/research support from Boehringer Ingelheim, Forest, GlaxoSmithKline, MAP, Merck, Novartis, Schering-Plough, Sepracor, Sunovion, Teva, and Watson; was a member of speakers bureau for AstraZeneca, GlaxoSmithKline, Merck, and Teva; and was a consultant for AstraZeneca, ISTA, MAP, Novartis, and Teva. N Eid was a consultant for Teva and a member of the speakers bureau for Teva and Merck. T Craig was a member of the speakers bureau for Teva. G Colice was a consultant and member of the speakers bureau for Teva, Boehringer Ingelheim, Pfizer, GlaxoSmithKline, Merck, Vatera, and MedImmune. M Hayden was a consultant for Teva, Dey Laboratory, and Sunovion, and a member of the speakers bureau for Merck. J Parsons was a consultant for Teva. S Stoloff received grant/research support from and was a consultant for Teva.

Address correspondence and reprint requests to Nancy K. Ostrom, M.D., Allergy and Asthma Medical Group and Research Center, 5776 Ruffin Road, San Diego, CA 92123
E-mail address: nancyostrom@allergyandasthma.com

Copyright © 2011, OceanSide Publications, Inc., U.S.A.

Table 1 Subject characteristics

	4–12 yrs of Age (%)	13–17 yrs of Age (%)
Sex, male/female	64.0/36.0	56.6/43.4
Weight (BMI)		
Underweight (<18.5)	52.8	19.5
Normal ($\geq$ 18.5 to <25)	33.9	50.9
Overweight ($\geq$ 25 to <30)	7.5	16.8
Obese ($\geq$ 30)	5.9	12.8
Diagnosis of EIB or EIA	16.3	33.9
Use of quick-relief medication in past 12 mo	57.9	96.4

BMI = body mass index; EIA = exercise-induced asthma; EIB = exercise-induced bronchospasm.

of five (39%) having these exercise-induced symptoms at least twice a week.⁶

Despite its high prevalence, there still has not been a large database analysis that has focused on exercise-induced bronchospasm (EIB) as reflected by exercise-related asthma symptoms. The EIB Landmark Survey is the first comprehensive, national survey evaluating EIB in the general public and among asthma patients (adult sample),⁷ as well as data from health care providers. It is also the first large study to characterize EIB in pediatric patients (split into younger children aged 4–12 years and adolescents aged 13–17 years). Here, we report results of the survey in these specific patient populations.

METHODS

Study Design

This national survey was conducted using telephone interviews between December 8, 2009, and January 3, 2010. The survey was conducted by the National Public Opinion Research Organization Abt SRBI, Inc., in partnership with Strategic Pharma Solutions, LLC, and sponsored by Teva Specialty Pharmaceuticals, LLC.

The 84 questions included in the survey were developed with input from a faculty of primary care and asthma specialists. The questions were structured to obtain relevant data on demographics, symptoms experienced, and the impact of EIB on daily function. Subjects were guaranteed confidentiality and participation was voluntary.

Patients

Patients were identified by systematically screening a national list sample of households reporting one or more persons with asthma. Current asthma patients were defined as persons diagnosed with asthma and having experienced an asthma attack or asthma symptoms within the past year or currently taking medication for their asthma. The asthma sample included children (4–17 years) and adults ($\geq$ 18 years). The re-

sults for only the children with asthma are reported here and the results of the adult asthma sample are reported separately.⁷ In households with more than one eligible patient, the computer-assisted telephone interviewing system randomly selected one person by age as the designated patient. If the designated patient was aged 4–17 years, the adult most knowledgeable about that patient's asthma and its treatment was interviewed.

Data Analysis

Data analysis was performed by Abt SRBI, Inc. Pediatric patients were split into two groups: younger children aged 4–12 years and adolescents aged 13–17 years. The patient sample was weighted by age and gender using estimates obtained from the 2008 National Health Interview Survey. Those with current asthma were selected from the 2008 National Health Interview Survey data, and then age and gender estimates were obtained from this subgroup of respondents. The weights were computed based on these estimates and then applied to the EIB patient sample.

The maximum expected sampling error for a simple random sample of 1000 was ± 3.1 percentage points at the 95% confidence level. Differences between the younger children and adolescent age groups were tested for using the z-test for two proportions.

RESULTS

In total, the parents of 516 children (250 aged 4–12 years; 266 aged 13–17 years) with asthma were surveyed. The survey took an average of 27.6 minutes to complete. Baseline demographics and clinical characteristics are presented in Table 1; twice as many parents of adolescent children (33.9%) reported that their child was diagnosed (method of diagnosis not recorded) with EIB or exercise-induced asthma compared with those who had younger children (16.3%). The majority of younger children (aged 4–12 years; 62.8%) and adolescents (aged 13–17 years; 96.4%) with

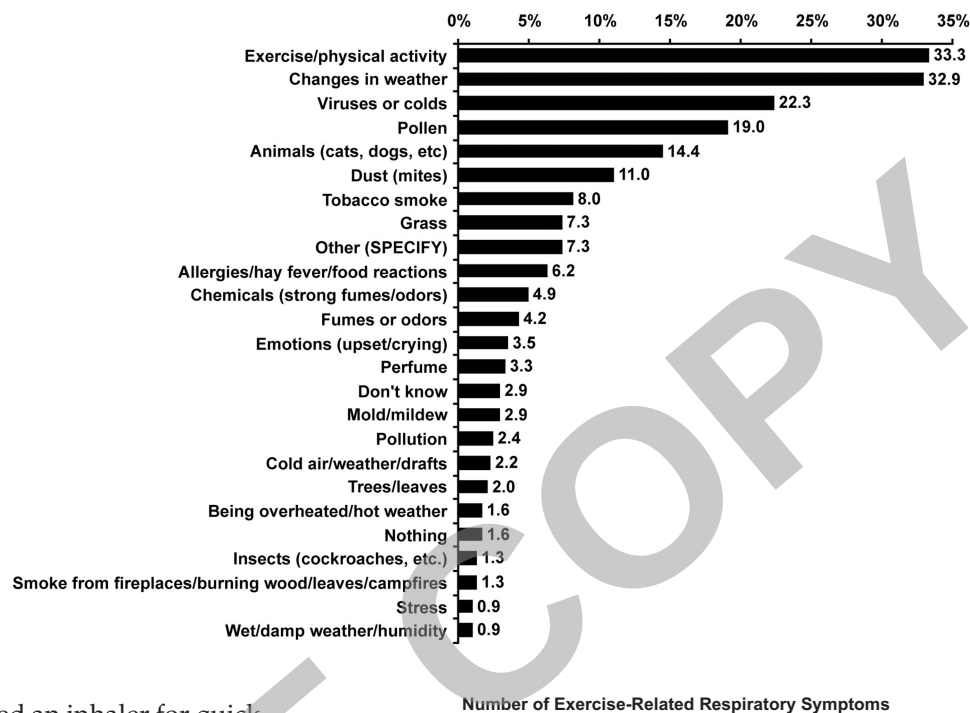


Figure 1. Common triggers reported by the parents of children with asthma.

asthma were reported to have used an inhaler for quick relief or rescue in the past year.

Asthma Triggers

Multiple triggers ("something that makes their asthma worse") were reported (Fig. 1). Exercise was the most commonly volunteered trigger (33.3%), followed closely by weather changes (32.9%).

Exercise-Related Respiratory Symptoms

The majority of parents of children with asthma (78.8%) reported that their child experienced at least any one of six exercise-related respiratory symptoms (shortness of breath, wheezing, coughing, difficulty taking a deep breath, noisy breathing, or chest tightness) and almost one-half (45.6%) experienced four or more of these symptoms (Fig. 2). The three most frequently reported symptoms were coughing (62.3%), shortness of breath (61.4%), and wheezing (52.5%). Of those who reported their children as having exercise-related respiratory symptoms, 41.6% reported that the child's symptoms lasted no longer than 10 minutes. Almost one-third (29.7%) of patients were reported to have symptoms lasting 11–30 minutes. However, 21.9% indicated their child's symptoms lasted until use of rescue medication (Fig. 3).

Only 23.1% of children with asthma with exercise-related respiratory symptoms were reported to take quick-relief medications such as albuterol "always" or "most of the time" before exercising (Fig. 4 A). This proportion was higher in adolescents than in younger children (29.9% versus 19.3%, respectively; $p < 0.05$).

Similarly, 27.6% of children with asthma with exercise-related respiratory symptoms were reported to

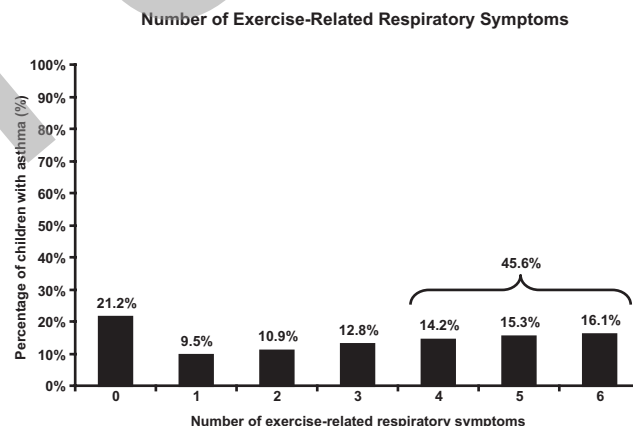


Figure 2. Number of exercise-related respiratory symptoms ($n = 516$). Symptoms included coughing, shortness of breath, wheezing, difficulty getting a deep breath, noisy breathing, and chest tightness after sports, exercise, play, or other physical activity.

take quick-relief medications "always" or "most of the time" during or after exercise (Fig. 4 B). Again, this proportion was higher in adolescents than in younger children (37.4% versus 22.1%, respectively; $p < 0.05$).

Quality of Life and Burden of Disease

Although the majority of parents (75.8%) responded that their child could keep up in physical activities "better or about the same" as other persons their own age, almost one-quarter (24.1%) said that their child did not do as well. Respondents considered asthma to limit their child's ability to participate either "a lot" or "some" in sports and recreation (30.0%: "a lot," 8.4%, and "some," 21.6%), outdoor activities (26.3%: "a lot," 6.9%, and "some," 19.4%), and in gym or physical

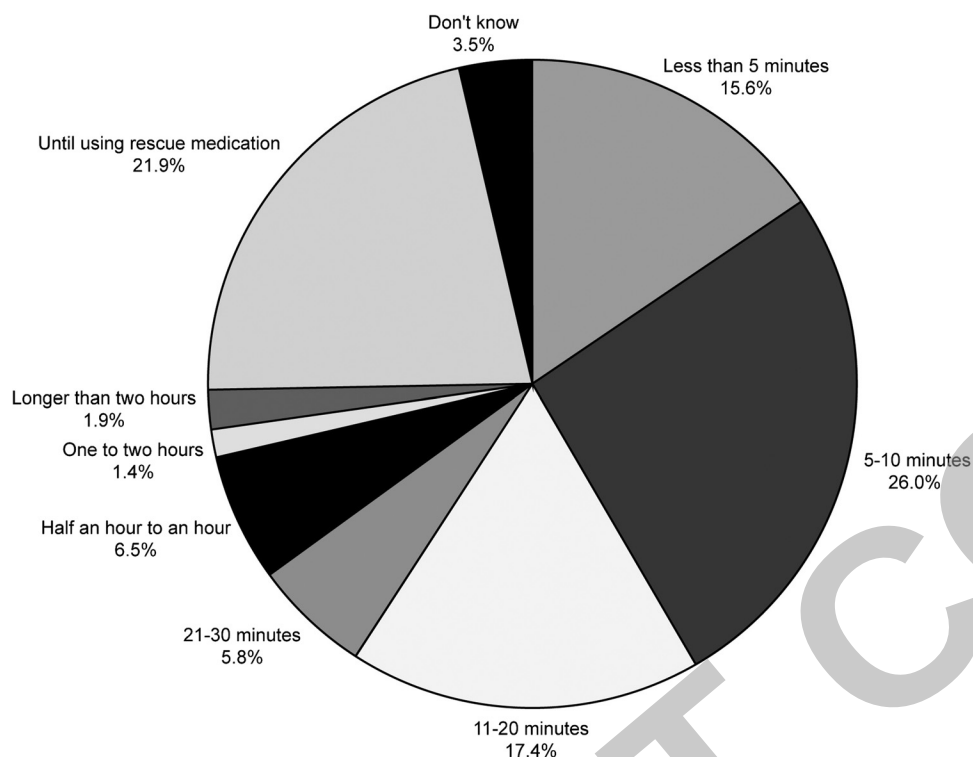


Figure 3. Average duration of exercise-related respiratory symptoms.

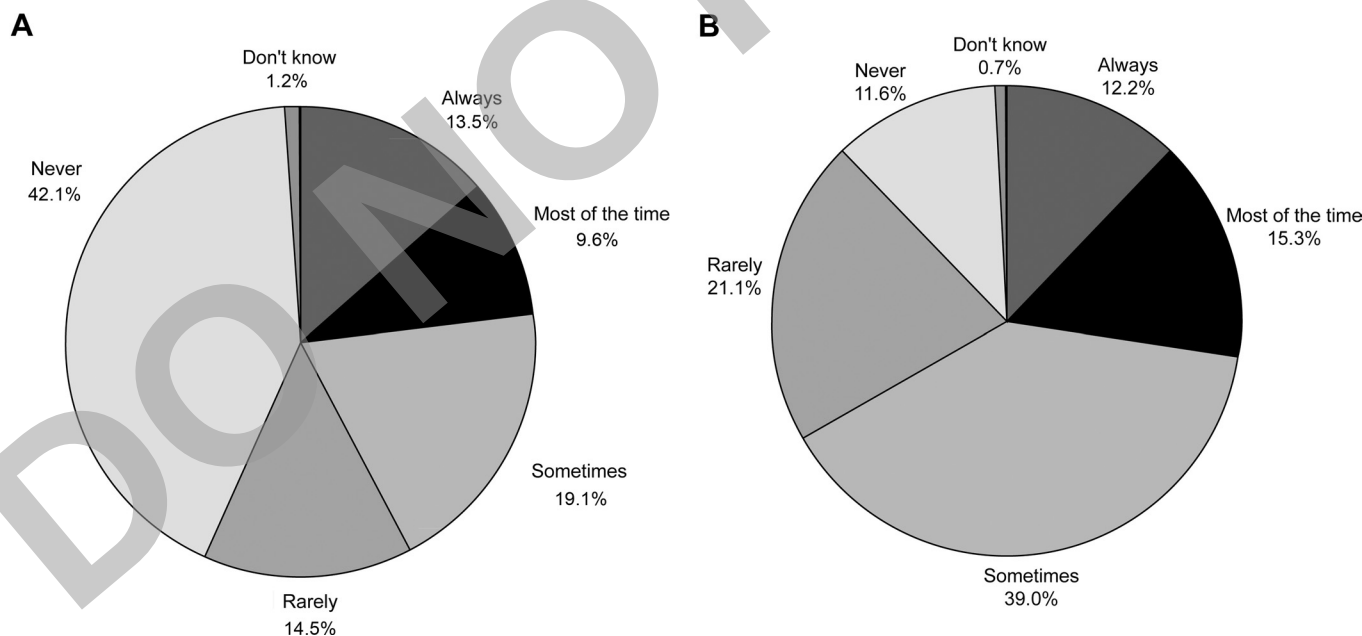


Figure 4. Proportion of children who take quick relief medications (A) before exercising and (B) during or after exercise.

education class (23.2%: “a lot,” 7.5%, and “some,” 15.7%) (Table 2). Almost twice as many parents of adolescent children with asthma indicated that their child’s health interfered “a lot” with his/her ability to participate in school sports compared with parents of younger children with asthma (12.5% versus 6.5%). Similarly, parents of adolescent children with asthma reported a higher incidence of their child

avoiding activities because of asthma symptoms (31.8% versus 22.2%).

DISCUSSION

This is the first comprehensive, national survey to focus on EIB and its impact on quality of life in children and adolescents aged 4–17 years. Results of this survey revealed that exercise-related respiratory symp-

Table 2 Survey participants who responded that their child's asthma limited him/her "a lot" or "some"

Activity	4–12 yrs of Age (%)	13–17 yrs of Age (%)	All Children (%)
Sports and recreation	27.0	35.4	30.0
Outdoor activities (e.g., biking and hiking)	24.2	30.2	26.3
Active participation in gym or physical education class	21.1	27.1	23.2
Normal physical exertion	20.3	22.2	20.9
Doing well in school	8.7	12.5	10.0
Doing things with family*	8.2	13.5	10.1
Social activities	7.9	12.4	9.5
School activities (e.g., plays and clubs)	5.9	8.8	6.9

* $p < 0.05$ for 4- to 12-year-old group vs 13- to 17-year-old group. All other comparisons were not significantly different.

toms are common in children and adolescents with asthma, contributing to the burden of disease and significantly affecting quality of life. The survey also confirmed that asthma is not well controlled in many patients, with EIB being one possible marker for that underlying lack of control.

It is well established that people with asthma can safely exercise and that this should be encouraged.⁸ Indeed, studies have shown that an exercise program in children with severe asthma results in significant health and quality-of-life benefits.⁹ However, this survey found a considerable burden of disease affecting the ability of children and adolescents to participate in sports and exercise. Overall, parents of adolescent children (aged 13–17 years) with asthma reported more limitations in their child's physical and/or school activities than the parents of younger children (aged 4–12 years); more parents of adolescent children with asthma indicated their symptoms interfered "a lot" with their child's ability to participate or perform well in school sports compared with those of younger children with asthma. Importantly, a higher percentage of parents of adolescent children with asthma reported that their child avoided physical activities because of asthma symptoms compared with those of younger children with asthma. It is interesting to note that, in the present survey, adolescent children with asthma were three times more likely to be overweight or obese than younger children with asthma. The relationship between asthma and obesity is complex,¹⁰ and it is likely that each has an impact on the development of the other. In that regard, one study of adolescents found that those with an earlier age at asthma diagnosis were more likely to be overweight, suggesting that developmental factors may be involved in the relationship between asthma and obesity.¹¹ The course of obesity is often marked by small but steady weight gain over childhood.¹² Therefore, it is conceivable that the behavioral changes observed in this study, such as diminished physical activity, increase the risk of developing obesity.

Asthma symptoms during exercise could certainly contribute to diminished physical activity in children and adolescents. This survey revealed that exercise was the most frequently reported asthma "trigger." The majority of parents (78.8%) of children with asthma reported that their child had at least one exercise-related respiratory symptom including shortness of breath, wheezing, coughing, difficulty taking a deep breath, noisy breathing, or chest tightness. Almost one-half (45.6%) experienced four or more of these symptoms, most commonly coughing, shortness of breath, wheezing, and difficulty taking a deep breath. However, only 16.3% of younger children and 33.9% of adolescents had received a diagnosis of EIB. Parents reported that their child's duration of exercise-related respiratory symptoms was generally short (<10 minutes, 41.6%) or resolved within 11–30 minutes (29.7%). However, one in five reported that their child's symptoms lasted until use of their rescue inhaler. This is critical because parents are administering medications to younger children, whereas older children are likely to deliver the medication themselves. Indeed, when planning asthma management within the school environment, this survey highlights the need to note symptoms of EIB and to ensure that it is evaluated for proper diagnosis and proactively managed during physical education and sports activities. Despite national guidelines recommending the use of short-acting β -agonists as a preventive measure for EIB,^{13–15} only 23.1% of children with exercise-related respiratory symptoms were reported by their parents to take quick-relief medications such as albuterol "always" or "most of the time" before exercising.

Potential limitations of this survey include the fact that it was conducted by proxy and that the results were based on parental report without confirmation from medical records. Furthermore, the authors acknowledge that the presence of exercise-related symptoms does not necessarily mean that the patient has EIB. Indeed, the presence of EIB should be formally documented with proper objective testing.

In summary, the results of this survey suggest that exercise-related respiratory symptoms among asthma patients are common and may reflect uncontrolled asthma, including a lack of preventative treatment for these symptoms. Exercise intolerance, whether because of EIB or other causes, must be seriously considered by health care providers as an element of overall health maintenance. A thorough evaluation is warranted because other conditions can mimic EIB, such as vocal cord dysfunction, exercise-induced gastroesophageal reflux, and, most commonly, deconditioning. When EIB is suspected in children with asthma, chronic aggressive treatment of any underlying asthma should be pursued according to nationally accepted guidelines. The exercise-related respiratory symptoms reported in this study substantially limited the ability of children to participate normally and perform optimally in physical activities, with adolescents compromised to a greater extent than younger children. Importantly, the survey also highlights that many children are not using short-acting bronchodilators before exercise as recommended in national guidelines. Current treatment guidelines, including adherence to controller therapy and prevention of EIB symptoms with short-acting bronchodilators, should be followed to support optimal health in children and adolescents.

ACKNOWLEDGMENTS

The authors acknowledge the technical and editorial support provided by ApotheCom.

REFERENCES

- Centers for Disease Control and Prevention. Asthma fast facts. www.cdc.gov. Accessed September 18, 2010.
- Liu AH, Gilsenan AW, Stanford RH, et al. Status of asthma control in pediatric primary care: Results from the pediatric Asthma Control Characteristics and Prevalence Survey Study (ACCESS). *J Pediatr* 157:276–281.e3, 2010.
- Moonie SA, Sterling DA, Figgs L, et al. Asthma status and severity affects missed school days. *J Sch Health* 76:18–24, 2006.
- McIvor RA, Boulet LP, FitzGerald JM, et al. Asthma control in Canada: No improvement since we last looked in 1999. *Can Fam Physician* 53:672–677, 2007.
- Asthma Insight and Management (AIM) survey: Executive summary 2009. www.takingaimatasthma.com. Accessed November 18, 2011.
- Ostrom N, Nathan R, Lanier B, et al. A comprehensive survey of healthcare professionals and asthma patients offering insight on current treatment gaps and emerging device options (C.H.O.I.C.E.) study: Patient perception of symptoms control. *J Allergy Clin Immunol* 125:AB250, 2009 (Abs).
- Parsons JP, Craig TJ, Stoloff SW, et al. Impact of exercise-related respiratory symptoms in adults with asthma: Exercise-induced bronchospasm landmark national survey. *Allergy Asthma Proc* 32:431–437, 2011.
- Randolph C. Exercise-induced bronchospasm in children. *Clin Rev Allergy Immunol* 34:205–216, 2008.
- Weisgerber M, Webber K, Meurer, et al. Moderate and vigorous exercise programs in children with asthma: Safety, parental satisfaction, and asthma outcomes. *Pediatr Pulmonol* 43:1175–1182, 2008.
- Sutherland ER. Obesity and asthma. *Immunol Allergy Clin North Am* 28:589–602, 2008.
- Abramson NW, Wamboldt FS, Mansell AL, et al. Frequency and correlates of overweight status in adolescent asthma. *J Asthma* 45:135–139, 2008.
- Guo SS, Wu W, Chumlea WC, et al. Predicting overweight and obesity in adulthood from body mass index values in childhood and adolescence. *Am J Clin Nutr* 76:653–658, 2002.
- Weiler JM, Anderson SD, Randolph C, et al. American Academy of Allergy, Asthma and Immunology; American College of Allergy, Asthma and Immunology; Joint Council of Allergy, Asthma and Immunology. Pathogenesis, prevalence, diagnosis, and management of exercise-induced bronchoconstriction: a practice parameter. *Ann Allergy Asthma Immunol* 105:S1–S47, 2010.
- Bateman ED, Hurd SS, Barnes PJ, et al. Global strategy for asthma management and prevention: GINA executive summary. *Eur Respir J* 31:143–178, 2008.
- Grzelewski T, and Stelmach I. Exercise-induced bronchoconstriction in asthmatic children: A comparative systematic review of the available treatment options. *Drugs* 69:1533–1553, 2009. □