

Impact of exercise-related respiratory symptoms in adults with asthma: Exercise-Induced Bronchospasm Landmark National Survey

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

ABSTRACT

An estimated 5–20% of the general population and up to 90% of people with asthma experience exercise-induced bronchospasm (EIB). The EIB Landmark Survey is the first comprehensive study on exercise-related respiratory symptoms in the United States. Two surveys were conducted: the first surveyed adults (≥ 18 years) in the general public and the second surveyed adults with asthma or taking medications for asthma in the prior year. Parameters assessed included exercise-related respiratory symptoms, activity levels, and short-acting beta-antagonist (SABA) use. In the general public survey ($n = 1085$), 8% were currently diagnosed with asthma. However, 29% reported experiencing one or more of six respiratory-related symptoms during or immediately after exercising. In the EIB in adult asthma survey ($n = 1001$), although $>80\%$ of adults experienced one or more of six exercise-related respiratory symptoms, only 30.6% reported a diagnosis of EIB. Almost one-half (45.6%) of adults with asthma reported that they avoid physical activities because of symptoms. Despite symptoms, only 22.2% of respondents took SABAs before exercise “always” or “most of the time”; 36.3% took rescue medications after or during exercise. Exercise-related respiratory symptoms limit physical activities and negatively impact daily lives. However, adults in the United States lack awareness of EIB. Although many subjects stated that their asthma symptoms limit their physical activity, few adhered to treatment guidelines by using SABAs appropriately before exercising. Findings from this survey support the need for better communication about the proper evaluation and management of EIB in the community and in asthma patients.

(Allergy Asthma Proc 32:431–437, 2011; doi: 10.2500/aap.2011.32.3501)

Exercise-induced bronchoconstriction (EIB) is experienced by a majority of the estimated 23 million individuals who have asthma in the United States.^{1,2} The term EIB is used to describe the phenomenon of

transient airway narrowing that occurs during or after physical exertion. Although its pathogenesis is still not fully understood, it is thought that it probably results from exercise-induced hyperventilation and changes in airway physiology.³ The most common symptoms of EIB include cough, wheezing, chest tightness, unusual shortness of breath, and/or excess mucus after a burst of strenuous and continuous aerobic exercise. In most cases, symptoms occur during or minutes after vigorous activity and, typically, the last several minutes.⁴ The severity of symptoms can vary from mild impairment during physical activity to severe bronchospasm leading to respiratory failure and even death.⁵

It has long been recognized that exercise and physical activity are common triggers of exercise-related respiratory symptoms in patients with asthma. However, it is increasingly clear that a significant number of individuals in the general population have respiratory symptoms in response to exercise without having a diagnosis of persistent asthma. Although EIB has been estimated to occur in ~ 5 –20% of the general population,¹ there has been no consensus. Public awareness of the condition is generally low, and the symptoms are often attributed to deconditioning and situational fatigue. In addition, both underdiagnosis and overdiagnosis have been reported on symptoms alone.¹ More-

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

J Parsons was a consultant for Teva. T Craig was a member of the speakers bureau for Teva. S Stoloff received grant/research support from and was a consultant for Teva. M Hayden was a consultant for Teva, Dey Laboratory, and Sunovion, and a member of the speakers bureau for Merck. 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. G Colice was a consultant and member of the speakers bureau for Teva, Boehringer Ingelheim, Pfizer, GlaxoSmithKline, Merck, Vatera, and MedImmune

Address correspondence and reprint requests to Jonathan P. Parsons, M.D., M.Sc., FCCP, Ohio State University Asthma Center, Pulmonary, Allergy, Critical Care, and Sleep Medicine, 201 Davis Heart Lung Research Institute, 473 West 12th Avenue, Columbus, Ohio 43210

E-mail address: jonathan.parsons@osumc.edu

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

over, a proper diagnosis of EIB requires objective pulmonary function testing. EIB, therefore, likely remains an underdiagnosed and undertreated condition.

In patients with chronic asthma, exercise-induced symptoms may be a manifestation of poor asthma control.^{3,6,7} For example, recent large surveys of asthma such as the comprehensive survey of health-care professionals and asthma patients offering insight on current treatment gaps and emerging device options (CHOICE) survey found that more than one-half (56%) of adults and adolescents with asthma reported symptoms during exercise, play, or physical exertion in the past 4 weeks, with 39% having these exercise-induced symptoms at least twice a week.⁸ Treatment strategies for EIB are well established and are effective in the majority of patients. The most commonly used pharmacologic therapy for EIB is an inhaled short-acting β -agonist (SABA), which can be used to both prevent and treat symptoms. Guidelines recommend the prophylactic use of an SABA inhaler, such as albuterol, 15–30 minutes before starting moderate exercise.¹ By using an SABA and warming up for a short period of time, the average noncompetitive athlete with EIB can usually exercise without experiencing acute symptoms.³

Despite the high prevalence of EIB, there still has not been a large database analysis that has focused on exercise-related respiratory symptoms in the general population with and without asthma. We report here the results of the first large national survey of the general public and patients with asthma regarding asthma and exercise-related respiratory symptoms in the United States.

METHODS

Study Design

Two national surveys assessing EIB in subjects were conducted using telephone interviews. The EIB in the general public survey was conducted December 7–21, 2009, and the EIB in Asthma survey was conducted December 8, 2009, to January 3, 2010. The surveys were 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. All participants were interviewed after consenting to participate in the voluntary surveys. Respondents were made aware of the purpose of the surveys at the start of the interview, but company sponsorship was only disclosed at the end of the surveys.

Both surveys were developed with input from a faculty of primary care and asthma specialists. The EIB in the general public survey included 78 questions regarding demographics, general health, awareness of EIB, and EIB symptoms experienced. The EIB in

Asthma survey included 84 questions regarding demographics, symptoms experienced, and impact of EIB on daily function.⁹ The majority of survey questions had multiple answer options for the respondent to choose from and respondents were not required to answer all questions.

Subjects

The EIB in the general public survey was conducted in adults (aged ≥ 18 years) in the general public, selected by random-digit dialing.

For the EIB in Asthma survey, subjects were identified by systematically screening a national list sample of households reporting one or more persons with asthma. The asthma sample included children (aged 4–17 years) and adults (aged ≥ 18 years). Only the results for the adult asthma sample are reported here; the results of the pediatric asthma sample are reported separately.¹⁰ Current subjects with asthma were defined as persons diagnosed with asthma who have experienced an asthma attack or asthma symptoms within the past year or currently take medication for their asthma. In households with more than one eligible patient, the computer-assisted telephone interviewing system randomly selected one person by age as the designated patient.

Data Analysis

Data analysis was performed by Abt SRBI, Inc. The maximum expected sampling error for a simple random sample of 1000 was +3.1 percentage points at the 95% confidence level. The sample of adult subjects with asthma was weighted by age and gender using estimates obtained from the 2008 National Health Interview Survey. Those currently suffering from 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.

Differences between subjects with asthma and EIB symptoms and subjects with asthma but no EIB symptoms were tested by using the *z* test for two proportions.

RESULTS

Subject Characteristics

In total, 1085 adults in the general public, of whom 999 did not currently have asthma and 86 did have asthma, were surveyed using the EIB in the general public survey. A total of 1001 adults with asthma were surveyed using the EIB in Asthma survey. The survey for the general adult population averaged 7.5 minutes and the survey for the asthma population averaged 25.9 ± 7.6 minutes.

Table 1 Subject characteristics

	General Public (<i>n</i> = 1085)		Asthma Population (<i>n</i> = 1001)
	Nonasthma (<i>n</i> = 999)	Asthma (<i>n</i> = 86)	
Age (mean [yr])	47.5	45.4	33.5
Gender (%)			
Male	49.3	35.1	44.5
Female	50.7	64.9	55.5
Race (%)			
Asian or Pacific Islander	3.1	—	1.9
American Indian or Alaskan native	2.2	2.1	3.2
Black or African American	10.8	10.9	6.4
White	77.6	67.0	86.7
Mixed	0.7	3.7	1.2
Hispanic	4.3	11.2	1.6
Refused	2.1	5.1	0.8
Weight (%)			
Underweight (BMI <18.5)	4.8	5.2	1.0
Normal (BMI ≥18.5 and <25)	34.2	15.5	27.1
Overweight (BMI ≥25 and <30)	32.2	42.3	28.1
Obese (BMI ≥30)	28.8	37.1	43.7
General health status			
Excellent	24.0	12.4	7.0
Very good	31.4	27.8	27.7
Good	30.6	27.8	35.3
Only fair	10.0	14.4	20.5
Poor/very poor	3.3	17.5	9.4
Not sure	0.2	—	0.1
Household income			
\$10,000 or less	7.8	18.5	8.7
\$10,001–25,000	13.7	14.4	14.8
\$25,001–50,000	20.6	15.5	26.2
\$50,001–75,000	15.2	16.55	12.2
\$75,001–100,000	11.1	5.2	10.8
Over \$100,000	14.6	8.3	9.2
Do not know	5.1	7.2	6.5
Refused	11.9	14.4	11.5

Subject demographics for both samples are given in Table 1. The majority of respondents were white, and the mean age was 45.4–47.5 years in the general public survey and 33.5 years in the asthma survey. More people with asthma were considered overweight or obese and reported fair or poor health compared with the nonasthma population, and more people in the nonasthma population reported excellent or good health compared with those with asthma.

The EIB in the General Public Survey

In total, 14% of the general population had been diagnosed as having asthma; more specifically, 8% reported having a current diagnosis of asthma, and 5% reported having a diagnosis of asthma in the past with

no asthma-related symptoms or medication within the preceding 12 months.

Although only 5% of those surveyed were currently diagnosed as having EIB (29% of the asthma population and 2% of the nonasthma population), 26% reported experiencing one or more of the six common exercise-related respiratory symptoms suggestive of EIB (shortness of breath, wheezing, coughing, difficulty taking a deep breath, noisy breathing, or chest tightness during or immediately after exercising). This increased to 76% in those who reported a diagnosis of asthma (Fig. 1). There appeared to be a modest association between exercise-related symptoms and a diagnosis of EIB; the proportion of adults diagnosed with EIB was 7% for those who experienced 2 or fewer of

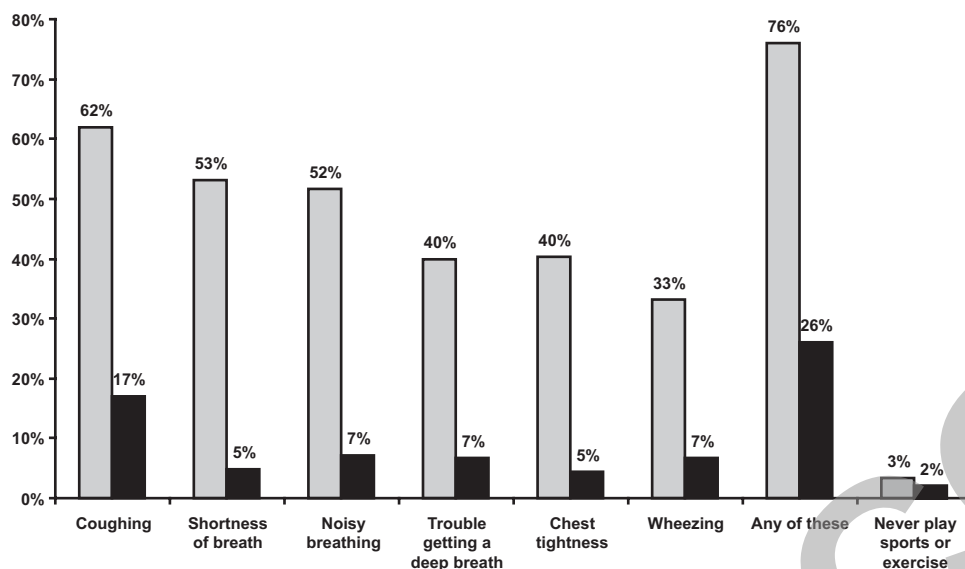


Figure 1. Frequency of exercise-induced respiratory symptoms in the general population (with and without a diagnosis of asthma).

these symptoms and 35% for those who experienced six of the exercise-related symptoms.

More people with asthma indicated that their health interferes with their ability to participate and perform well in sports and other recreational activities versus those without asthma (52% versus 20%, respectively; $p < 0.001$). Similarly, over twice as many adults with asthma compared with those without (42% versus 17%; $p < 0.001$) indicated a lot or some limitations in activities with normal physical exertion. However, when questioned about their awareness of EIB, 37% of people with asthma had not previously heard of EIB or exercise-induced asthma (EIA) and this increased to 59% ($p < 0.001$) of people without asthma.

The EIB in Asthma Survey

Asthma Triggers. Although there were many different triggers listed, exercise (30.9%), weather changes (30.1%), and dust mites (22.7%) were the most commonly reported asthma triggers in respondents with asthma (Fig. 2).

Exercise-Related Respiratory Symptoms. In total, 30.6% of adults with asthma already had a diagnosis of EIB. However, 83% of adults reported that they experience one or more of the six exercise-related respiratory symptoms after sports, exercise, play, or other physical activity. Moreover, 53.6% reported four or more of these symptoms, and 25% reported all six symptoms. The most frequently reported exercise-related symptoms were shortness of breath (70.9%), wheezing (62.6%), and trouble getting a deep breath (56.1%).

Of those who reported having exercise-related respiratory symptoms, 54.6% of respondents with asthma

reported that the symptoms lasted no longer than 10 minutes. By contrast, however, 8.2% reported that the symptoms lasted >30 minutes and 15.6% reported that their symptoms persisted until rescue medication was used.

Medication Use

Use of rescue medication was high; 18.3% of asthma subjects reported using their rescue inhaler on a daily basis for symptoms; 10.6% reported they used their inhalers three to six times per week (both suggesting their asthma was not controlled); and only 24.1% responded that they had not used it within the past year.

Of those who reported having exercise-related symptoms, only 22.2% of subjects reported taking quick-relief medications such as albuterol “always” or “most of the time” before exercising. A higher percentage (36.3%) reported they took it during or after exercise in response to their symptoms. Of those diagnosed with EIB or EIA, 38% reported using a rescue inhaler before exercise, 19% reported using it during exercise, and 47% reported using it after exercise (Fig. 3).

Quality of Life and Burden of Disease

Respondents felt that asthma limited their ability to participate either “a lot” or “some” in sports/recreation (46.1%), normal physical exertion (39.8%), and other outdoor activities such as biking/hiking (47.8%). Almost one-half (45.6%) of adults with asthma reported that they avoid activities because of their symptoms and a similar percentage (42.7%) indicated that they cannot keep up as well as other persons their own

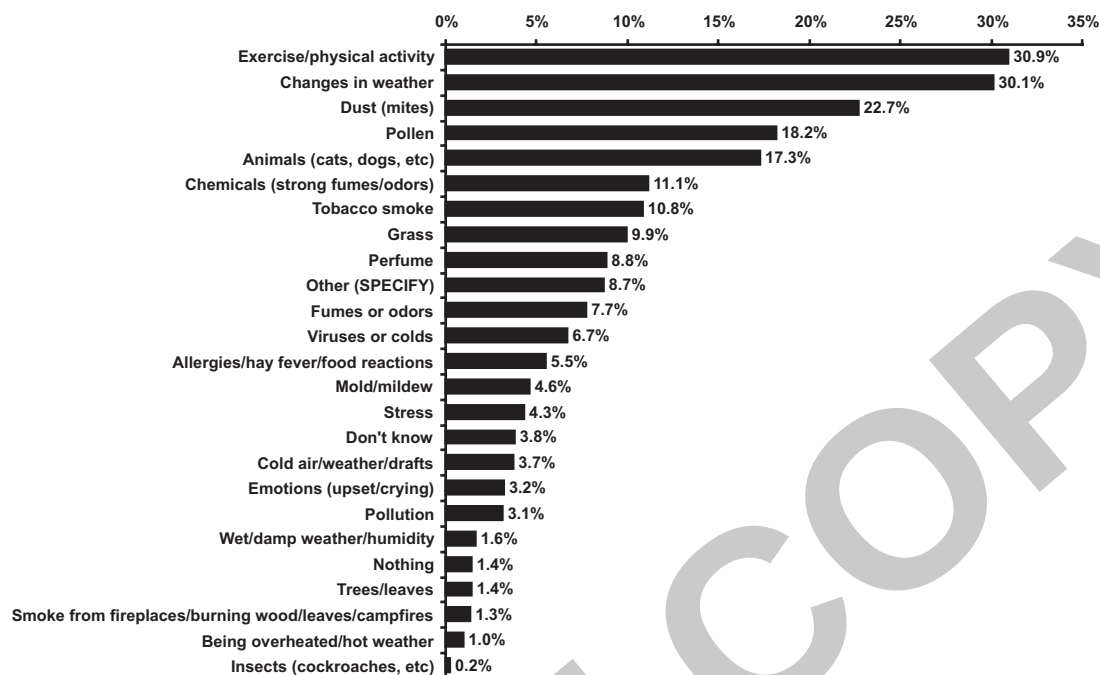


Figure 2. Common triggers.

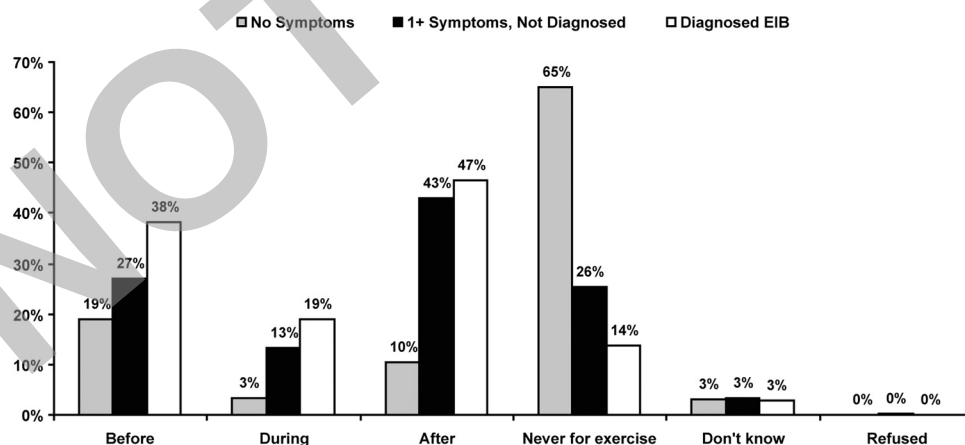


Figure 3. Rescue medicine use while exercising.

age in physical activities. Moreover, compared with subjects without EIB symptoms, subjects with asthma who experienced at least one EIB symptom reported feeling more fearful (10.9% versus 27.7%; $p < 0.001$), isolated (6.0% versus 15.1%; $p < 0.01$), depressed (9.1% versus 23.4%; $p < 0.001$), frustrated (22.9% versus 54.5%; $p < 0.001$), and embarrassed (4.2% versus 20.0%; $p < 0.001$).

DISCUSSION

This is the first comprehensive, national survey that focuses on exercise-induced respiratory symptoms in the general public and in those diagnosed with asthma. Limitations of this study include those that are inherent to all retrospective surveys, such as reliability of response and recall bias. A history of cough, shortness of breath, chest pain or tightness,

wheezing, or endurance problems during exercise suggests EIB. However, use of history alone has been shown to both underdiagnose and overdiagnose EIB.¹ To establish a diagnosis of EIB, an exercise challenge is often used, although additional indirect and direct bronchoprovocation tests can also be used to confirm diagnosis. Typically, a 10–15% decrease in peak expiratory flow or forced expiratory volume in 1 second after an indirect or direct bronchoprovocation test is compatible with EIB.^{1,6} Although medical history alone is neither specific nor sensitive for EIB, the large size of the survey provides the first “real-world” insight into the prevalence and impact of exercise-related respiratory symptoms in the United States.

The results of this survey clearly show that exercise-induced symptoms are not limited to persons

with known asthma. Although only 5% of the general public surveyed were diagnosed as having EIA or EIB, almost one-third of respondents reported experiencing at least one exercise-related respiratory symptom. Although the presence of exercise-related symptoms does not necessarily mean that the individual has EIB, it is interesting to note that there was only a modest association between number of common EIB-related symptoms and a current diagnosis of EIB. Indeed, of those individuals who experienced all six exercise-related respiratory symptoms, most (65%) had never been diagnosed with EIB. This implies that there is a large population of people with common exercise-related respiratory symptoms who do not have a formal diagnosis of EIB. It is likely that many of these respondents actually may not have EIB despite presence of respiratory symptoms during exercise, but it presents a valuable opportunity for health care providers to discuss exercise limitations with their patients.

The high prevalence of exercise-related respiratory symptoms in the general public also urgently highlights the need for a greater focus and better communication in the community. Of particular concern is the significant proportion of people who indicated that they had not previously heard of EIB. Even more worrisome is the observation that 37% of those with asthma were not aware of the significance of exercise-related symptoms as a potential marker for poor asthma control. Lack of awareness of EIB and its likely underdiagnosis in both the general and the asthma communities may contribute to poor management of these conditions and may negatively impact quality of life.

The EIB in Asthma survey confirms previous reports that exercise-related symptoms are very common in people with asthma.^{11,12} In this survey, >80% of those with asthma reported at least one exercise-related respiratory symptom, but only 30.6% had a diagnosis of EIB. Similar to the earlier Asthma Insight and Management survey, this survey found that the most frequently reported "triggers" were exercise and changes in weather. However, despite the majority of respondents with asthma reporting at least one exercise-related symptom, only one-third actually considered exercise a trigger for their asthma.

People with asthma reported a significant physical burden of disease, as evidenced by lower self-health ratings and increased activity limitations compared with persons without asthma. For example, nearly one-half of respondents with asthma reported that their health interferes with their ability to participate and perform well in sports and other physical activities. It is therefore perhaps inevitable that more subjects with asthma (in both surveys) were reported

to be either overweight or obese compared with the nonasthma population. Importantly, the ability to participate and perform well in sports and other physical activities was directly impacted by the presence of EIB; almost 40% of subjects with exercise-related respiratory symptoms reported that they could not keep up as well as others their own age. Moreover, respondents with asthma who reported the presence of EIB-associated symptoms reported feeling more fearful, isolated, depressed, frustrated, and embarrassed than persons without EIB symptoms.

Finally, the survey highlights the urgent need for better asthma education. The fact that almost one-third of people with asthma have to take asthma rescue medication at least three to six times weekly supports the suggestion that exercise-related symptoms among patients with asthma reflect uncontrolled or improperly managed asthma. Despite guidelines recommending the use of SABA as preventive measures for EIB,^{1,13} this survey found that less than one-quarter of respondents with EIB-associated symptoms used an SABA, such as albuterol, before exercising. Even when the person already had a diagnosis of EIB, the majority (57%) of those who used a quick-relief inhaler did not use it before exercise. For individuals with asthma to be able to undertake normal levels of activity, it is necessary to manage asthma appropriately and to minimize or prevent EIB. Patient education for EIB should include discussion of which activities are most likely to cause symptoms and under what conditions. Information should also be provided on the proper use of pharmacotherapy, particularly controller medications, in treating EIB, and consideration of nonpharmacologic approaches to minimizing EIB symptoms. Most importantly, patients and physicians should be made aware that—with proper therapy—the majority of patients with EIB (including elite athletes) should be able to perform at their desired levels of activity.

ACKNOWLEDGMENTS

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

REFERENCES

1. 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.
2. Centers for Disease Control and Prevention. Asthma fast facts. Available online at www.cdc.gov/asthma; accessed September 18, 2010.
3. Storms W. Challenges in the management of exercise-induced asthma. *Expert Rev Clin Immunol* 5:261–269, 2009.

4. Tan RA, and Spector SL. Exercise-induced asthma. *Sports Med* 25:1–6, 1998.
5. DiDario AG, and Becker JM. Asthma, sports, and death. *Allergy Asthma Proc* 26:341–344, 2005.
6. National Asthma Education and Prevention Program. Expert Panel Report 3 (EPR-3): Guidelines for the diagnosis and management of asthma—Summary report 2007. *J Allergy Clin Immunol* 120:S94–S138, 2007.
7. Randolph C. An update on exercise-induced bronchoconstriction with and without asthma. *Curr Allergy Asthma Rep* 9:433–438, 2009.
8. 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).
9. EIB: A landmark survey. www.eiblandmarksurvey.com. Accessed November 15, 2011.
10. Ostrom N, Eid N, Craig T, et al. Exercise-induced bronchospasm in children with asthma in the United States: Results from the EIB landmark survey. *Allergy Asthma Proc* 35:425–430, 2011.
11. Weiler JM. Exercise-induced asthma: A practical guide to definitions, diagnosis, prevalence, and treatment. *Allergy Asthma Proc* 17:315–325, 1996.
12. Rabe KF, Adachi M, Lai CK, et al. Worldwide severity and control of asthma in children and adults: The global asthma insights and reality surveys. *J Allergy Clin Immunol* 114:40–47, 2004.
13. 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. □