ORIGINAL ARTICLE

A New Symptom-Based Questionnaire for Predicting the Presence of Asthma

B Shin, SL Cole, S-J Park, DK Ledford, RF Lockey

Division of Allergy and Clinical Immunology, Department of Internal Medicine, University of South Florida College of Medicine, James A. Haley Veterans' Medical Center, Tampa, Florida

Abstract

Background: Early diagnosis and treatment of asthma is important for improving health and minimizing the social and economic burden of the disease. A simple questionnaire would provide a convenient and timesaving tool to help physicians diagnose asthma.
Objective: The senior author developed a simple, pre-interview screening questionnaire—the Asthma Screening Questionnaire (ASQ)—consisting of 6 questions. The present report provides performance evidence that the ASQ is a reliable instrument for diagnosing asthma in adults.
Methods: Participants were asthmatics or controls, aged 18 to 65 years. All participants completed the questionnaire (self-administered and physician-administered), and underwent spirometry and a methacholine challenge test (if there was no reversibility during initial spirometry). Sensitivity, specificity, and positive and negative predictive values were calculated for each question, and the total scores of asthmatics were compared with those of controls. The degree of agreement between the self-administered and the physician-administered questionnaire was calculated.
Results: The main symptoms discriminating asthmatics from controls were cough more than average (88% vs 0%), cough from chest (72% vs 0%), shortness of breath with exercise (84% vs 16%), and chest tightness when lying down (72% vs 4%). A cutoff point of total score ≥4 was associated with the highest combination of sensitivity (96%) and specificity (100%). Substantial agreement was observed between the self-administered and the physician-administered questionnaire (κ statistic, 0.56-1.00; $P<.0001$).
Conclusions: The ASQ is a simple, inexpensive, and efficient pre-interview screening tool to diagnose asthma.

Key words: Asthma. Diagnosis. Patient questionnaire. Physician questionnaire.

Resumen

Antecedentes: El diagnóstico precoz y el tratamiento temprano del asma son fundamentales para mejorar la salud y minimizar la carga social y económica de la enfermedad. Un sencillo cuestionario proporcionaría una herramienta práctica y rápida para ayudar a los médicos a diagnosticar el asma.
Objetivo: El autor principal elaboró un sencillo cuestionario de detección previo a la entrevista, el Cuestionario para la detección del asma (CDA), consistente en 6 preguntas. El presente artículo proporciona pruebas del funcionamiento del CDA como un instrumento fiable para diagnosticar el asma en adultos.
Métodos: Los participantes eran asmáticos o controles, con edades comprendidas entre los 18 y los 65 años. Todos los participantes completaron el cuestionario (autoadministrado y administrado por el médico), y se sometieron a una espirometría y a una prueba de provocación con metacolina (en caso de no presentar reversibilidad durante la espirometría inicial). Para cada pregunta se calcularon la sensibilidad, la especificidad y los valores predictivos positivos y negativos, y se compararon las puntuaciones totales de los asmáticos con las de los controles. Se calculó el grado de concordancia entre el cuestionario autoadministrado y el administrado por el médico.
Resultados: Los síntomas principales que distinguieron a los asmáticos de los controles fueron la tos por encima de la media (88% frente a 0%), la tos de pecho (72% frente a 0%), la dificultad para respirar durante el ejercicio físico (84% frente a 16%) y la opresión torácica al acostarse (72% frente a 4%). Un valor de corte de puntuación total ≥4 se asoció a la combinación máxima de sensibilidad (96%) y especificidad (100%). Se observó una notable concordancia entre el cuestionario autoadministrado y el administrado por el médico (estadístico κ, 0,56-1,00, $p < 0,0001$).
Conclusiones: EL CDA es una herramienta de detección previa a la entrevista, sencilla, económica y eficaz, para diagnosticar el asma.

Palabras clave: Asma. Diagnóstico. Cuestionario del paciente. Cuestionario del médico.

Introduction

Asthma affects approximately 300 million people worldwide, making it one of the most common chronic diseases in the world [1]. It accounts for 250,000 deaths per year worldwide [2] and 1.7 million emergency room visits per year in the United States [3], where the annual cost of asthma is increasing [4]. In 2002, children aged 5 to 17 years missed 14.7 million school days and adults 11.8 million workdays due to asthma in the United States [5].

There is no single diagnostic test or symptom that defines asthma, a disease consisting of a constellation of symptoms, including wheeze, cough, shortness of breath, and chest tightness. In many cases, the diagnosis is not in question, as the disease is quickly recognized and appropriately treated. In other cases, confounding factors make diagnosis both challenging and time-consuming for the physician and the patient. Given the frequent time constraints of clinical practice, a pre-interview questionnaire could expedite diagnosis.

Estimates of asthma prevalence in epidemiological studies are generated from questionnaires [6-8]. While several scoring questionnaires have been developed to measure asthma control [9-14], they are not routinely utilized to diagnose this disease. A validated diagnostic questionnaire would provide a tool that could improve clinical efficiency and optimize use of resources.

The senior author of the present study developed a simple and effective pre-interview screening questionnaire—the Asthma Screening Questionnaire (ASQ)—consisting of 6 questions. This instrument can be used in clinical practice to predict, with a high degree of certainty, the presence or absence of asthma in adults.

Methods

Participants

Screening was performed at participating clinics of the University of South Florida College of Medicine. Participants were recruited from patients referred to the Division of Allergy and Immunology for respiratory complaints, participants in prior clinical trials, and from individuals who responded to advertisements requesting people with asthma to participate in the study. Eligible participants between 18 and 65 years of age were divided into 2 groups, asthmatic patients and controls. Participants were classified as having asthma if they had both of the following: 1) a diagnosis of asthma within the past 12 months and 2) ≥12% and ≥200 cc increase in forced expiratory volume in 1 second (FEV_1) with a short-acting $ß_2$-agonist or a positive methacholine challenge result (a 20% decrease in FEV_1 with a dose of <8 mg/mL of inhaled methacholine). Participants were classified as healthy controls if they fulfilled all of the following: 1) no history of asthma, 2) no prior treatment for asthma, and 3) no evidence of asthma after spirometry or methacholine challenge. The participant had to be able to read, understand, and record information in English. Each participant completed an evaluation and provided informed consent at baseline (visit 0), followed by study visit 1 (within 8 weeks of visit 0) and study visit 2 (within 2 weeks of visit 1). The study and advertisements were approved by our Institutional Review Board, and informed consent was obtained from all the participants.

Exclusion Criteria

Pregnant and breastfeeding women were excluded and all women of childbearing potential underwent a urine pregnancy test at the beginning of the study. Other exclusion criteria included the following: 1) hospitalization for respiratory disease within 6 months prior to visit 0; 2) current diagnosis of cystic fibrosis, pneumonia, pneumothorax, atelectasis, pulmonary fibrotic disease, chronic bronchitis, or any other lower respiratory tract abnormalities; 3) an allergic reaction or intolerance to $ß_2$-agonists or sympathomimetic medication; 4) confirmed or suspected infection of the sinus, middle ear, oropharynx, upper respiratory tract, or lower respiratory tract within 28 days prior to visit 0; 5) any clinically significant, uncontrolled condition or disease that, in the opinion of the investigator, would put the safety of the participant at risk by participating or would confound the interpretation of the results in the case of an exacerbation. This list of conditions/diseases includes, but is not limited to, cardiac arrhythmia, congestive heart failure, coronary artery disease, Addison disease, diabetes mellitus, dyspnea by any cause other than asthma, uncontrolled hypertension, chronic disease (blood, liver, nervous system, thyroid, stomach, or kidneys), immunosuppression, current malignancy, and tuberculosis; 6) current use of ß-blockers, systemic corticosteroids, or angiotensin converting enzyme inhibitors; or 7) history of ≥10 lifetime pack-years of cigarette smoking, current use of any tobacco products, or use of any tobacco products within 1 year prior to baseline.

Procedure

At baseline, participants who met the eligibility criteria gave their informed consent to participate. At visit 1, each participant completed the questionnaire and underwent a physical examination. Spirometry with reversibility was assessed with an inhaled short-acting $ß_2$-agonist. Participants were required to fill out the first questionnaire before seeing the physician. The physician administered the same questionnaire later the same day. At visit 2, all participants without reversibility on initial spirometry underwent methacholine challenge testing. The physician questioning or examining the participant was blinded to the study group.

Data Sources

Asthma Screening Questionnaire. A simplified 6-item questionnaire was developed based on common questions used at clinics affiliated with the University of South Florida, and in recommendations from the National Asthma Education and Prevention Program and the Global Initiative for Asthma [15,16]. After patients had completed the questionnaire, a physician administered the same questionnaire to ensure that all questions had a response and to clarify any ambiguities. The questionnaire consists of 6 questions in a yes/no answer format. Questions 1 and 2 assess cough, whereas questions 3 to

Table 1. Scoring System of the Asthma Screening Questionnaire

Questionnaire	Score
1. Do you congh more than the average person?	2
2. Do you have a cough that comes mainly from your chest and NOT from your throat?	2
3. Do you have worsening of the following symptoms when you lie down to sleep?	
Cough	1
Chest tightness	1
Wheeze	1
Shortness of breath	1
4. Do you have worsening of the following symptoms after exercise or physical activity?	
Cough	1
Chest tightness	1
Wheeze	1
Shortness of breath	1
5. Do you have worsening of the following symptoms after laughing or crying?	
Cough	1
Chest tightness	1
Wheeze	1
Shortness of breath	1
6. Do you have worsening of the following symptoms after talking on the phone?	
Cough	1
Chest tightness	1
Wheeze	1
Shortness of breath	1

6 address 4 dimensions of asthma symptoms including cough, chest tightness, wheeze, and shortness of breath in 4 commonly associated provoking conditions. All questions have an equal weight of 1 point except for the first 2 questions, which have 2 points each. A total ASQ score was calculated as the sum of all positive responses, ranging from 0 to 20 (see Table 1).

Pulmonary Function Studies. Trained study personnel performed spirometry with a KoKo Portable Spirometer (Pulmonary Data Services Inc, Louisville, Colorado, USA). Spirometry was performed according to American Thoracic Society (ATS) guidelines [17]. To establish reversibility, participants inhaled 2 puffs (180 μg) of albuterol. The best expiratory effort was selected using ATS criteria [17]. An improvement in FEV_1 of ≥12% and ≥200 mL after inhaling albuterol established reversibility. Prior to the visit, participants avoided short-acting inhaled bronchodilators for at least 8 hours.

*Methacholine Challenge Test.*The test was performed according to ATS guidelines [18]. The dosing protocol was 0.0625 mg/mL, 0.25 mg/mL, 1 mg/mL, 4 mg/mL, and 16 mg/mL. A decrease of ≥20% of baseline FEV_1 with a dose of <8 mg/mL of methacholine was considered a positive response (PC_{20} ≤8 mg/mL). The methacholine test was considered negative if the PC_{20} was >16 mg/mL and indeterminate if the PC_{20} was >8-16 mg/mL (considered a negative response in this study). The test was not performed on anyone with a prebronchodilator FEV_1 <65% of predicted. The test was administered at least 8 hours after short-acting bronchodilators and 48 hours after long-acting bronchodilators.

Statistical Analysis

The distribution of demographic characteristics and baseline variables between the asthma and control groups was compared using the χ^2 and *t* tests. The answers of the self-administered questionnaire were compared with those of the physician-administered questionnaire, and the degree of agreement was calculated by measuring the Cohen κ index.

Results

Sample Characteristics

Of the 25 participants in the asthma group, 3 did not meet the spirometric criteria for asthma and subsequently had a positive result in the methacholine challenge test. All controls had negative results in spirometry and the methacholine challenge test. The baseline characteristics of both the asthma group and control group are shown in Table 2. The asthma and control groups did not differ from each other in age, gender, or past smoking history, but they did show significant differences in baseline spirometry results.

Symptoms Differentiating Asthmatics From Controls

The response "yes" to coughing more than the average person was higher in asthmatics than in controls (88% vs 0%), and of those who answered "yes" to the first question, all but four stated that cough primarily originated from the chest. Other symptoms with a high prevalence in asthmatics

Table 2. Patient Characteristics at Baseline[a]

	Asthma (n=25)	Control (n=25)	*P* Value
Age	35.9 (9.5)	32.4 (14.4)	.3131
Male gender, n	6	10	.2253
Smoking, n	9	5	.2077
FEV, L	2.6 (0.7)	3.6 (1.0)	.0002
FEV_1, %	77.6 (15.8)	99.2 (13.1)	<.0001
FVC, L	3.4 (1.1)	4.3 (1.2)	.0060
FVC, %	85.3 (17.5)	99.6 (10.6)	.0011
FEV_1/FVC, %	77.3 (8.8)	83.3 (4.9)	.0049
ICS, n	3[b]	0	.2347

Abbreviations: FEV_1, forced expiratory volume in 1 second; FVC, forced vital capacity; ICS, inhaled corticosteroid.
[a]Values are expressed as mean (SD) unless otherwise specified.
[b]All 3 asthmatics had been on inhaled corticosteroids for less than 6 months.

in decreasing order include shortness of breath with exercise (84%), chest tightness when lying down (72%), cough or chest tightness with exercise (64%), and shortness of breath with laughing or crying (64%) (Table 3). Cough, chest tightness, and wheeze while talking on the phone were not significantly associated with the diagnosis of asthma.

Performance in Each Questionnaire and Optimal Cutoff Value of the Total Symptom Score

Table 4 summarizes the sensitivity, specificity, and positive and negative predictive values of each question. Symptoms while talking on the phone were the least sensitive. Table 5 lists the values of sensitivity, specificity, and positive and negative predictive values of the selected cutoff points for the ASQ score. A cutoff point of total symptom score equal to or greater than 4 was associated with the highest combination of sensitivity (96%) and specificity (100%). With an increased cutoff point, sensitivity decreased, while specificity remained at 100%.

Agreement of the Questionnaire

All but two κ values showed substantial or almost perfect agreement (>0.6) when the self-administered and physician-

Table 3. Number of Patients Who Responded "Yes"

Questionnaire	Patients Who Responded "Yes"		
	Asthmatics, No. (%) (n=25)	Controls, No. (%) (n=25)	*P* Value
More cough than average	22 (88.0)	0 (0.0)	<.0001
Cough from chest	18 (72.0)	0 (0.0)	<.0001
Lying down to sleep			
Cough	14 (56.0)	0 (0.0)	<.0001
Chest tightness	18 (72.0)	1 (4.0)	<.0001
Wheeze	11 (44.0)	0 (0.0)	<.0001
Shortness of breath	12 (48.0)	0 (0.0)	<.0001
Exercise or physical activity			
Cough	16 (64.0)	1 (4.0)	<.0001
Chest tightness	16 (64.0)	1 (4.0)	<.0001
Wheeze	12 (48.0)	0 (0.0)	<.0001
Shortness of breath	21 (84.0)	4 (16.0)	<.0001
Laughing or crying			
Cough	14 (56.0)	2 (8.0)	<.0001
Chest tightness	11 (44.0)	0 (0.0)	<.0001
Wheeze	8 (32.0)	0 (0.0)	<.0001
Shortness of breath	16 (64.0)	2 (8.0)	<.0001
Talking on the phone			
Cough	5 (20.0)	0 (0.0)	.5015
Chest tightness	4 (16.0)	0 (0.0)	.1099
Wheeze	2 (8.0)	0 (0.0)	.4898
Shortness of breath	7 (28.0)	0 (0.0)	.0096

Table 4. Sensitivity, Specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) of Each Question

Questionnaire	Sensitivity, %	Specificity, %	PPV, %	NPV, %
More cough than average	88.0	100.0	100.0	89.3
Cough from chest	72.0	100.0	100.0	78.1
Lying down to sleep				
Cough	56.0	100.0	100.0	69.4
Chest tightness	72.0	96.0	94.7	77.4
Wheeze	44.0	100.0	100.0	64.1
Shortness of breath	48.0	100.0	100.0	65.8
Exercise or physical activity				
Cough	64.0	96.0	94.1	72.7
Chest tightness	64.0	96.0	94.1	72.7
Wheeze	48.0	100.0	100.0	65.8
Shortness of breath	84.0	84.0	84.0	84.0
Laughing or crying				
Cough	56.0	92.0	87.5	67.6
Chest tightness	44.0	100.0	100.0	64.1
Wheeze	32.0	100.0	100.0	59.5
Shortness of breath	64.0	92.0	88.9	71.9
Talking on the phone				
Cough	20.0	100.0	100.0	55.6
Chest tightness	16.0	100.0	100.0	54.3
Wheeze	8.0	100.0	100.0	52.1
Shortness of breath	28.0	100.0	100.0	58.1

Table 5. Sensitivity, Specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) of the Combined Scores of Questions

Total Score If Equal to or Greater Than	Sensitivity, %	Specificity, %	PPV, %	NPV, %
1	100.0	72.0	78.1	100.0
2	100.0	84.0	86.2	100.0
3	96.0	96.0	96.0	96.0
4	96.0	100.0	100.0	96.2
5	92.0	100.0	100.0	92.6
6	92.0	100.0	100.0	92.6
7	88.0	100.0	100.0	89.3
8	76.0	100.0	100.0	80.6
9	72.0	100.0	100.0	78.1
10	64.0	100.0	100.0	73.5

administered questionnaires were compared. The question on wheeze when lying down to sleep (κ=0.562) or shortness of breath with laughing or crying (κ=0.584) showed moderate agreement (see Table 6).

Discussion

These data show that the ASQ is a simple and effective questionnaire to predict which individuals are more likely to have asthma. It is reproducible whether it is self-administered or doctor-administered. A significant difference was observed between the mean ASQ scores of asthmatic patients and those of controls.

The most commonly used measures of asthma in epidemiologic and clinical studies are symptom data, specifically cough, wheeze, shortness of breath, and chest tightness [19]. The ASQ addresses the above 4 symptoms with specific triggers, although these triggers have yet to be validated. The ASQ symptom score was weighted more on

Table 6. Measurement of Interobserver Agreement

Questionnaire	κ Coefficient[a]	*P* Value
More cough than average	0.918	<.0001
Cough from chest	0.826	<.0001
Lying down to sleep		
Cough	0.951	<.0001
Chest tightness	0.735	<.0001
Wheeze	0.562	<.0001
Shortness of breath	0.718	<.0001
Exercise or physical activity		
Cough	0.831	<.0001
Chest tightness	0.733	<.0001
Wheeze	0.689	<.0001
Shortness of breath	0.720	<.0001
Laughing or crying		
Cough	0.774	<.0001
Chest tightness	0.605	<.0001
Wheeze	0.608	<.0001
Shortness of breath	0.584	<.0001
Talking on the phone		
Cough	0.778	<.0001
Chest tightness	0.878	<.0001
Wheeze	1.000	<.0001
Shortness of breath	0.765	<.0001

[a]A κ of 1 indicates perfect agreement, whereas a κ of 0 indicates chance agreement.

cough than the other symptoms, because cough seems to be an earlier and more recognizable symptom in newly diagnosed asthma. Dyspnea or chest tightness is more likely to be caused by cardiopulmonary conditions; however, it is considered less reliable, because of the greater dependence on patient perception. The questionnaire also differentiated between patients with cough originating from the chest (substernal) and those with "ticklish" cough (laryngeal), caused by upper respiratory conditions such as upper airway disease or gastroesophageal reflux disease.

The purpose of any screening test is to identify an individual with a high chance of having a certain disease and who requires further clinical assessment to confirm the diagnosis. Choosing the optimal cutoff value is a trade-off between optimizing sensitivity and specificity. At a cutoff value of 4, sensitivity remained high (>90%), with 100% specificity. A higher cutoff value kept specificity at 100%, with lower sensitivity.

Agreement for 2 administrations of the same questionnaire is an appropriate measure of reliability [20], and there is evidence that interviewer-administered and self-administered respiratory symptom questionnaires are comparable [20,21]. The κ statistic was used to estimate the reliability of the questionnaires applied in the present study. Since the interval between successive administrations of questionnaires is important, all the answers were acquired on the same day with an interval of at least 30 minutes. This time interval between the first and second questionnaire was assumed to be long enough for participants to forget their responses to the first questionnaire, but not sufficiently long that a change in the clinical condition could occur. There was significant agreement in the answers for cough, wheezing, chest tightness, and shortness of breath.

Validating an asthma questionnaire is not a straightforward process, since there is no generally accepted operational definition of asthma. Therefore, the outcome of the validation will depend on which operational definition of the disease is used. Validation requires questionnaires to be tested against a clinical physiologic investigation, such as measuring the reversibility of airway obstruction and the results of a bronchial challenge test [22-24]. Other studies have validated asthma questionnaires against a physician's diagnosis of asthma [25,26]; however, these studies are often flawed, because the criteria for asthma diagnosis are not specified. If the validation is based on the opinion of a single physician or a panel of physicians, there may be a considerable bias in the diagnosis. This new questionnaire could also be compared to a previously validated one [22,27], except that previously validated questionnaires often lack a scoring system that makes true comparison difficult. Each method is limited in that it either underdiagnoses or overdiagnoses asthma.

The American College of Allergy, Asthma, and Immunology developed a simple self-administered questionnaire, the Life

Quality (LQ) test, to help individuals with breathing problems determine whether they have asthma or, for those already diagnosed with asthma, to determine whether their asthma is under control. It is a useful and valid asthma-screening tool, since a high LQ score corresponds to a higher probability of diagnosis [28,29]. However, the LQ test is mainly designed to determine the effect of asthma on quality of life. It is a complex questionnaire that addresses 6 dimensions of the impact of asthma on a patient's quality of life including activity, symptoms, triggers, health care use, medications, and psychological aspects. The ASQ is a shorter and simpler questionnaire concentrating on 4 general symptoms: cough, wheeze, chest tightness, and shortness of breath.

Our study has several limitations. Although the results show that the ASQ could prove useful when screening patients for asthma, the sample size is relatively small; therefore, the questionnaire needs to be tested in larger groups under a variety of clinical situations. Furthermore, the study is limited to relatively healthy adults to control the confounding variables as much as possible.

These data show that the ASQ has a higher sensitivity and specificity for diagnosis of asthma than currently validated asthma questionnaires, although this could be due to the recruitment of skewed populations. Individuals with clinically suspected asthma were likely to report more positive symptoms since they were mainly recruited from the clinic; in contrast, the controls were mainly asymptomatic healthy volunteers with no confounding comorbid conditions.

Assessing the likelihood of asthma by counting the number of "yes" answers to questions is a simple but relatively crude method, since it assumes equal weight for all questions. Some responses may exert a stronger influence than others. As with all questionnaires, the answers may depend on factors other than the disease status of the respondent. Cultural, psychological, and sociological factors can all affect the replies to particular questions. Overstatement or understatement of symptoms to physicians can also produce differences in responses. Large variations in perception of respiratory symptoms, particularly with dyspnea, have been observed among asthmatics, thus limiting the value of questionnaires [30]. Furthermore, psychological factors such as anxiety, anger, depression, and cognitive disturbances can influence symptom reporting.

There is increasing demand for asthma to be diagnosed as early as possible. Studies suggest that treatment of asthma should be initiated quickly, before any permanent lung function abnormalities develop [31]. In a busy clinical practice, a simple scoring system that reliably identifies asthmatic patients needing further review is highly desirable. The ASQ is an efficient screening tool for suspected asthma patients in that it is simple, inexpensive, and quick (2 minutes to complete). In populations with limited knowledge of asthma symptoms or low literacy, there may be even greater advantages in using the ASQ.

In conclusion, this pilot study shows that the ASQ is a simple and inexpensive approach to predict which individuals are most likely to be diagnosed with asthma and for efficient pre-interview of suspected asthma patients. Nevertheless, further evaluation in a large prospective study including a more diverse population is required to fully validate this questionnaire.

Acknowledgments

We wish to thank Ren Chen, MD, University of South Florida, for her assistance with the statistical analysis.

References

1. Masoli M, Fabian D, Holt S, Beasley R. The global burden of asthma: executive summary of the GINA Dissemination Committee report. Allergy. 2004;59(5):469-78.
2. Bousquet J, Bousquet PJ, Godard P, Daures JP. The public health implications of asthma. Bull World Health Organ. 2005;83(7):548-54.
3. McCaig LF, Burt CW. National Hospital Ambulatory Medical Care Survey: 2001 emergency department summary. Adv Data. 2003 Jun 4(335):1-29.
4. Weiss KB, Sullivan SD. The health economics of asthma and rhinitis. I. Assessing the economic impact. J Allergy Clin Immunol. 2001;107(1):3-8.
5. Rose D, Mannino DM, Leaderer BP. Asthma prevalence among US adults, 1998-2000: role of Puerto Rican ethnicity and behavioral and geographic factors. Am J Public Health. 2006;96(5):880-8.
6. Asher MI, Keil U, Anderson HR, Beasley R, Crane J, Martinez F, Mitchell EA, Pearce N, Sibbald B, Stewart AW. International Study of Asthma and Allergies in Childhood (ISAAC): rationale and methods. Eur Respir J. 1995;8(3):483-91.
7. Burney PG, Luczynska C, Chinn S, Jarvis D. The European Community Respiratory Health Survey. Eur Respir J. 1994;7(5):954-60.
8. Kable S, Henry R, Sanson-Fisher R, Ireland M, Corkrey R, Cockburn J. Childhood asthma: can computers aid detection in general practice? Br J Gen Pract. 2001;51(463):112-6.
9. Nathan RA, Sorkness CA, Kosinski M, Schatz M, Li JT, Marcus P, Murray JJ, Pendergraft TB. Development of the asthma control test: a survey for assessing asthma control. J Allergy Clin Immunol. 2004;113(1):59-65.
10. Juniper EF, Svensson K, Mork AC, Stahl E. Measurement properties and interpretation of three shortened versions of the asthma control questionnaire. Respir Med. 2005;99(5):553-8.
11. Liu AH, Zeiger R, Sorkness C, Mahr T, Ostrom N, Burgess S, Rosenzweig JC, Manjunath R. Development and cross-sectional validation of the Childhood Asthma Control Test. J Allergy Clin Immunol. 2007;119(4):817-25.
12. Skinner EA, Diette GB, Algatt-Bergstrom PJ, Nguyen TT, Clark RD, Markson LE. The Asthma Therapy Assessment Questionnaire (ATAQ) for children and adolescents. Dis Manag. 2004;7(4):305-13.
13. Wood PR, Smith B, O'Donnell L, Galbreath AD, Lara M, Forkner E, Peters JI. Quantifying asthma symptoms in adults: the Lara Asthma Symptom Scale. J Allergy Clin Immunol. 2007;120(6):1368-72.
14. Schatz M, Sorkness CA, Li JT, Marcus P, Murray JJ, Nathan RA, Kosinski M, Pendergraft TB, Jhingran P. Asthma Control Test: reliability, validity, and responsiveness in patients not previously followed by asthma specialists. J Allergy Clin Immunol. 2006;117(3):549-56.
15. Guidelines for the diagnosis and management of asthma expert panel report 2. [Internet Resource; Computer File Date of Entry:

20030529]: National Institutes of Health, National Heart, Lung, and Blood Institute; 1997 [updated 1997; cited]; Available from: http://www.ncbi.nlm.nih.gov/books/bv. Note: Access this title via National Center for Biotechnology Information. 1997.
16. Global strategy for asthma management and prevention. [Internet Resource; Computer File Date of Entry: 20030623]: National Institutes of Health, National Heart, Lung, and Blood Institute; 2002 [updated 2002; cited]; Rev. 2002. Available from: http://purl.access.gpo.gov/GPO/LPS32621
17. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, Crapo R, P Enright, van der Grinten CPM, Gustafsson P, Jensen R, Johnson DC, MacIntyre N, McKay R, Navajas D, Pedersen OF, Pellegrino R, Viegi G, Wanger J. Standardisation of spirometry. Eur Respir J. 2005;26(2):319-38.
18. Crapo RO, Casaburi R, Coates AL, Enright PL, Hankinson JL, Irvin CG, MacIntyre NR, McKay RT, Wanger JS. Guidelines for methacholine and exercise challenge testing-1999. This official statement of the American Thoracic Society was adopted by the ATS Board of Directors, July 1999. Am J Respir Crit Care Med. 2000;161(1):309-29.
19. O'Connor GT, Weiss ST. Clinical and symptom measures. Am J Respir Crit Care Med. 1994;149(2 Pt 2):S21-8; discussion S9-30.
20. Samet JM. A historical and epidemiologic perspective on respiratory symptoms questionnaires. Am J Epidemiol. 1978;108(6):435-46.
21. Lebowitz MD, Burrows B. Comparison of questionnaires: the BMRC and NHLI respiratory questionnaires and a new self-completion questionnaire. Am Rev Respir Dis. 1976;113(5):627-35.
22. Ravault C, Kauffmann F. Validity of the IUATLD (1986) questionnaire in the EGEA study. International Union Against Tuberculosis and Lung Disease. Epidemiological study on the Genetics and Environment of Asthma, bronchial hyperresponsiveness and atopy. Int J Tuberc Lung Dis. 2001;5(2):191-6.
23. Burney PG, Chinn S, Britton JR, Tattersfield AE, Papacosta AO. What symptoms predict the bronchial response to histamine? Evaluation in a community survey of the bronchial symptoms questionnaire (1984) of the International Union Against Tuberculosis and Lung Disease. Int J Epidemiol. 1989;18(1):165-73.
24. Enarson DA, Vedal S, Schulzer M, Dybuncio A, Chan-Yeung M. Asthma, asthmalike symptoms, chronic bronchitis, and the degree of bronchial hyperresponsiveness in epidemiologic surveys. Am Rev Respir Dis. 1987;136(3):613-7.
25. Burney PG, Laitinen LA, Perdrizet S, Huckauf H, Tattersfield AE, Chinn S, Poisson N, Heeren A, Britton JR, Jones T. Validity and repeatability of the IUATLD (1984) Bronchial Symptoms Questionnaire: an international comparison. Eur Respir J. Nov;2(10):940-5.
26. Bansal A, Farnham JM, Crapo RO, Hughes DC, Jensen RL, Cannon-Albright LA. A simple diagnostic index for asthma. Clin Exp Allergy. 2001;31(5):756-60.
27. Abramson MJ, Hensley MJ, Saunders NA, Wlodarczyk JH. Evaluation of a new asthma questionnaire. J Asthma. 1991;28(2):129-39.
28. Winder JA, Nash K, Brunn JW. Validation of a life quality (LQ) test for asthma. Ann Allergy Asthma Immunol. 2000;85(6 Pt 1):467-72.
29. Fonseca JA, Delgado L, Costa-Pereira A, Tavares C, Moreira A, Morete A, de Oliveira F, Rodrigues J, Vaz M. Evaluation of the Asthma Life Quality test for the screening and severity assessment of asthma. Allergy. 2004;59(11):1198-204.
30. Magadle R, Berar-Yanay N, Weiner P. The risk of hospitalization and near-fatal and fatal asthma in relation to the perception of dyspnea. Chest. 2002;121(2):329-33.
31. Haahtela T, Jarvinen M, Kava T, Kiviranta K, Koskinen S, Lehtonen K, Nikander K, Persson T, Selroos O, Sovijarvi A, Stenius-Aarniala B, Svahn T, Tammivaara R, Laitinen LA. Effects of reducing or discontinuing inhaled budesonide in patients with mild asthma. N Engl J Med. 1994 Sep 15;331(11):700-5.

Manuscript received April 18, 2009; accepted for publication May 16, 2009.

Richard F Lockey, MD

University of South Florida College of Medicine,
c/o VA Hospital
Division of Allergy and Immunology (111D)
13000 Bruce B. Downs Blvd.
Tampa, FL 33612

