numbers of aberrant T cells, serum IgE levels, and clinical features. Thus the disease appears to be stable, and we have no evidence for a transition into a T-cell lymphoma. However, because clonal T cells in the hypereosinophilic syndrome have been described as precursors of malignant T cells,[6,8] regular immunomonitoring of such patients is recommended.

We thank Dr D. R. Zimmermann (University of Zurich) for T-cell receptor gene rearrangement analysis.

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Supported by grants from the Swiss National Science Foundation (310000-107526); the Stanley Thomas Johnson Foundation, Bern; and the OPO-Foundation, Zurich.

Disclosure of potential conflict of interest: The authors have declared that they have no conflict of interest.

REFERENCES

1. Grimbacher B, Holland SM, Gallin JI, Greenberg F, Hill SC, Malech HL, et al. Hyper-IgE syndrome with recurrent infections—an autosomal dominant multisystem disorder. N Engl J Med 1999;340:692-702.
2. Grimbacher B, Holland SM, Puck JM. Hyper-IgE syndromes. Immunol Rev 2005;203:244-50.
3. Bonilla FA, Geha RS. Update on primary immunodeficiency diseases. J Allergy Clin Immunol 2006;117(suppl):S435-41.
4. Fanconi S, Seger RA, Willi U, Otto R, Spiess H, Kayser FH, et al. Oral chloramphenicol therapy for multiple liver abscesses in hyperimmunoglobulinemia E syndrome. Eur J Pediatr 1984;142:292-5.
5. Cogan E, Schandené L, Crusiaux A, Cochaux P, Velu T, Goldman M. Brief report: clonal proliferation of type 2 helper T cells in a man with the hypereosinophilic syndrome. N Engl J Med 1994;330:535-8.
6. Simon HU, Plötz SG, Dummer R, Blaser K. Abnormal clones of T cells producing interleukin-5 in idiopathic eosinophilia. N Engl J Med 1999; 341:1112-20.
7. Simon HU, Yousefi S, Dommann-Scherrer CC, Zimmermann DR, Bauer S, Barandun J, et al. Expansion of cytokine-producing CD4-CD8- T cells associated with abnormal Fas expression and hypereosinophilia. J Exp Med 1996;183:1071-82.
8. Simon HU, Plötz SG, Simon D, Dummer R, Blaser K. Clinical and immunological features of patients with interleukin-5-producing T cell clones and eosinophilia. Int Arch Allergy Immunol 2001;124:242-5.

Available online October 11, 2006.
doi:10.1016/j.jaci.2006.08.025

Developing measures of symptom perception for children with asthma

To the Editor:

Understanding how patients perceive symptoms is an important component of asthma management, because symptoms are used in self-management along with more objective measures such as monitoring peak expiratory flow rates. Symptom perception has important implications for management practices including medication usage and hospital visits. Much of previous research on how to quantify symptom perception in asthma has been conducted in adults[1]; here we report on the development and validity of 2 child-report asthma symptom perception measures.

Researchers have advocated a variety of approaches to measuring symptom perception in children with asthma.[2] However, the vast majority of research on childhood asthma symptom perception has relied on single-item measures of breathlessness,[3-5] with 1 study using 2 additional items, chest tightness and air hunger.[6] These methods parallel adult approaches such as the frequently used Borg scale for breathlessness.[7] However, if children have multidimensional ways of describing their asthma symptoms, as adults do,[8] this type of single-item assessment may not fully capture symptom perception in children. The current study developed words for a child symptom perception measure by asking children to describe their asthma when bronchospasm was present at the end of a methacholine challenge, and then tested associations of 2 symptom perception scales with pulmonary function both before and after bronchodilator treatment and methacholine challenge.

A total of 96 patients with mild to moderate asthma ages 6 to 15 years (mean age, 10.3 years; 55% male subjects; 18% minority subjects) were recruited from the Childhood Asthma Management Program (CAMP)[9] to develop the word list for the symptom perception measure. At a regularly scheduled study visit, methacholine challenge testing was conducted. After FEV_1 had decreased by at least 20% and before bronchodilator was given to reverse the bronchospasm, patients were asked, ''Are you experiencing any asthma symptoms at this time?'' and then ''Please describe your asthma symptoms,'' and ''Rate your asthma overall.''

A community asthma sample was then recruited to test the validity of our symptom perception measures. A total of 106 patients ranging in age from 5 to 15 years (mean age, 10.1 years; 60% male subjects; 45% minority subjects) were recruited from (1) the emergency department for acute asthma (N = 18), (2) the hospital within 24 hours after admission for acute asthma (N = 11), (3) the pulmonary function laboratory for evaluation before a regularly scheduled visit to the asthma clinic (N = 45), and (4) summer asthma camp at the time of registration (N = 32). Severity was assessed via baseline symptoms and chronic medication usage on the basis of criteria from the National Heart, Lung, and Blood Institute Asthma Guidelines. Pulmonary function was measured either using spirometry (pulmonary function laboratory) or Wright peak flow meter (Pulmonary Data, Boston, Mass) (emergency department, hospital, asthma camp), and calculated as a percent of predicted values based on age, sex, ethnicity, and height (spirometry) or sex and height (peak flow). The symptom perception scales were administered. A total of 66 children received albuterol in the emergency department, hospital, or pulmonary function laboratory and then repeated the symptom questions and pulmonary function test.

On the basis of the words provided by the CAMP sample, we created 2 measures. One was a single item rating of asthma using the most frequently reported intensity descriptor, *bad* (Overall Asthma Rating [OAR]; Table I). Second, we created the CAPS (Table I). We initially included those items that were most frequently used by children to describe their asthma: chest tightness,

TABLE I. Asthma symptom perception scales

OAR					
Rate your asthma	0	1	2	3	4
	None	A tiny bit/a little	More	A lot	Really bad
CAPS					
1. Rate any wheezing you feel	None	A tiny bit/a little wheezy	More wheezy	A lot more wheezy	Really wheezy
2. Rate any chest pain you feel	None	Hurts a little bit	Hurts more	Hurts a lot	Really hurts
3. Rate any chest tightness you feel	None	A little bit tight	Tighter	A lot tighter	Really tight
4. Rate any shortness of breath/ difficulty breathing	None	A little hard to breathe	Harder to breathe	A lot harder to breathe	Really hard to breathe

TABLE II. Symptoms reported at end of methacholine challenge by CAMP patients*

Symptom	No. reporting	Factor loadings
Chest tightness	73	0.83
Shortness of breath	61	0.82
Wheeze	51	0.80
Chest pain	9	0.83
Clogged throat	19	0.68

*Symptoms described by 5 or fewer participants included the following: tired; headache; congested; can't blow out; chest heavy; dizzy; dripping nose; hurts to breathe in; something in my stomach; throat sore; tough to inhale; hurts to breathe; phlegm in lungs; tight throat; burning throat; chest drowsy; dry throat; ears popping; feel a little slow; hard to talk; hoarse voice; hot, itchy chin; itchy throat; mucus production; noise in throat; nose whistling; stuffy nose; tickle in throat; and watery eyes.

wheeze, shortness of breath, clogged throat, and chest pain. We tested psychometric properties of these items using a principal components analysis to determine whether the 5 symptom questions loaded onto a single factor or multiple factors. Results revealed that the symptom questions loaded onto 1 factor (eigenvalue = 3.78). Factor loadings for each item (Table II) revealed that the items all loaded positively onto a single construct of symptom perception. However, clogged throat had the lowest loading.

We also conducted reliability analyses to determine the internal consistency of the 5-item CAPS scale. Cronbach α for the scale was high (0.85). The clogged throat question had the lowest correlation with the other items (<0.5 average correlation) and contributed the least to the overall α coefficient. Thus, we deleted this item from our scale (Table I).

We then tested predictive validity of the OAR and the 4-item CAPS by examining correlations of symptom perception with pulmonary function measures in the community asthma sample. Controlling for asthma severity, pulmonary function correlated negatively with OAR ($r = –0.22$; $P < .05$) and CAPS ($r = –0.43$; $P < .001$). Correlations between pulmonary function and perception scales were repeated after bronchodilator treatment. Pulmonary function remained significantly correlated with the perception scales (OAR, $r = –0.30$, $P < .05$; CAPS, $r = –0.30$, $P < .05$). Both before and after bronchodilator administration, these correlations indicate that children with poorer lung function perceive greater asthma symptoms.

In addition, we tested associations of change in pulmonary function from pretreatment to posttreatment with change in symptom perception. After controlling for asthma severity, change in pulmonary function (percent difference in predicted values from pretreatment to posttreatment) was marginally correlated with the amount of change in OAR (controlling for baseline values; $r = -0.24$; $P = .06$), but not with change in CAPS ($r = 0.05$; NS). The correlation for OAR indicates that as pulmonary function increased over time, perception of asthma symptoms decreased.

Last, we examined whether age moderated any of these associations by testing for age interactions in the analyses. None was significant.

In a CAMP sample of 103 participants tested 10 to 21 months after the development of the word list and containing 71 of the original group, we found a similar pattern of associations premethacholine and postmethacholine challenge, after controlling for asthma severity. Pulmonary function was correlated with symptom perception prechallenge (OAR, $r = –0.30$, $P < .01$; CAPS, $r = –0.27$, $P < .01$) and postchallenge (OAR, $r = –0.20$, $P < .05$; CAPS, $r = –0.16$, $P < .10$). Furthermore, the slope of symptom perception across doses of methacholine was inversely correlated with the slope of pulmonary function (OAR, $r = –0.20$, $P < .05$; CAPS, $r = –0.24$, $P < .05$). This indicates that the greater the increase in symptom perception during methacholine challenge, the steeper the drop in pulmonary function.

In sum, symptom perception reliably correlated with pulmonary function in a sample of children with asthma ranging in age from 5 to 15 years. Findings emerged across a diverse group, ranging from children attending an asthma summer camp to CAMP participants undergoing methacholine challenge to children hospitalized for exacerbations of asthma. Both the single-item OAR and the 4-item CAPS measures were associated with pulmonary function. In addition, change in pulmonary function after acute manipulation of lung function was associated with change in symptom perception. Finally, results suggested that these symptom perception measures are valid across a broad age range, because no differences in associations by age were found. Because asthma management is often based on families' abilities to detect and respond to symptoms, child-appropriate symptom perception measures are important for efforts to increase the accuracy of asthma symptom perception using words understandable to

children and with a simplified range of possible answers. Use of such scores should facilitate communication about asthma symptoms and hasten appropriate responses to exacerbations of asthma in children.

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Supported by the National Institutes of Health (N01-HR-16051, M01-RR-00036, HL57232, HL073975), the Human Early Learning Partnership, and the William T. Grant Foundation.

Disclosure of potential conflict of interest: The authors have declared that they have no conflict of interest.

REFERENCES

1. Banzett RB, Dempsey JA, O'Donnell DE, Wamboldt MZ. Symptom perception and respiratory sensation in asthma. Am J Respir Crit Care Med 2000;162:1178-82.
2. Fritz GK, Yeung A, Wamboldt MZ, Spirito A, McQuaid EL, Klein R, et al. Conceptual and methodologic issues in quantifying perceptual accuracy in childhood asthma. J Pediatr Psychol 1996;21:153-73.
3. Rietveld S, Kolk AM, Prins PJM. The influence of lung function information on self-reports of dyspnea by children with asthma. J Pediatr Psychol 1996;21:367-77.
4. Rietveld S, Prins PJM. The relationship between negative emotions and acute subjective and objective symptoms of childhood asthma. Psychol Med 1998;28:407-15.
5. Wamboldt MZ, Bihun JT, Szefler S, Hewitt J. Perception of induced bronchoconstriction in a community sample of adolescents. J Allergy Clin Immunol 2000;106:1102-7.
6. Julius SM, Davenport KL, Davenport PW. Perception of intrinsic and extrinsic respiratory loads in children with life-threatening asthma. Pediatr Pulmonol 2002;34:425-33.
7. Borg GAV. Psychophysical basis of perceived exertion. Med Sci Sports Exerc 1982;14:377-81.
8. Simon PM, Schwartzstein RM, Weiss JW, Fencl V, Teghtsoonian M, Weinberger SE. Distinguishable types of dyspnea in patients with shortness of breath. Am Rev Respir Dis 1990;142:1009-14.
9. Childhood Asthma Management Program Research Group. The Childhood Asthma Management Program (CAMP): design, rationale, and methods. Control Clin Trials 1999;20:91-120.

Available online October 18, 2006.
doi:10.1016/j.jaci.2006.08.031