ORIGINAL ARTICLE

Symptom reporting in childhood asthma: a comparison of assessment methods

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Arch Dis Child 2006;91:766-770. doi: 10.1136/adc.2006.096123

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Accepted 7 May 2006
Published Online First
16 May 2006

Background: One barrier to receiving adequate asthma care is inaccurate estimations of symptom severity.

Aims: To interview parents of children with asthma in order to: (1) describe the range of reported illness severity using three unstructured methods of assessment; (2) determine which assessment method is least likely to result in a "critical error" that could adversely influence the child's care; and (3) determine whether the likelihood of making a "critical error" varies by sociodemographic characteristics.

Methods: A total of 228 parents of children with asthma participated. Clinical status was evaluated using structured questions reflecting National Asthma Education and Prevention Panel (NAEPP) criteria. Unstructured assessments of severity were determined using a visual analogue scale (VAS), a categorical assessment of severity, and a Likert scale assessment of asthma control. A "critical error" was defined as a parent report of symptoms in the lower 50th centile for each method of assessment for children with moderate-severe persistent symptoms by NAEPP criteria.

Results: Children with higher severity according to NAEPP criteria were rated on each unstructured assessment as more symptomatic compared to those with less severe symptoms. However, among the children with moderate-severe persistent symptoms, many parents made a critical error and rated children in the lower 50th centile using the VAS (41%), the categorical assessment (45%), and the control assessment (67%). The likelihood of parents making a critical error did not vary by sociodemographic characteristics.

Conclusions: All of the unstructured assessment methods tested yielded underestimations of severity that could adversely influence treatment decisions. Specific symptom questions are needed for accurate severity assessments.

Asthma is the most common chronic illness of childhood,¹ causing significant morbidity from symptoms as well as impairment of quality of life and functional impairment.²⁻³ The National Heart, Lung, and Blood Institute's (NHLBI) National Asthma Education and Prevention Panel (NAEPP) Expert Panel 2⁴ and the British Thoracic Society (BTS)⁵ have issued definitive guidelines for clinicians providing care for children with asthma. The guidelines recommend daily preventive medications for all children with persistent symptoms. However, many children who should receive preventive medications are not receiving them.⁶⁻⁹ Poor and minority children are at highest risk for receiving inadequate preventive therapy for asthma, and these children likely are experiencing preventable morbidity.¹⁰⁻¹⁴

Communication regarding asthma symptoms is essential, since guideline implementation requires clinicians to have accurate information about symptoms to classify severity and determine the necessary therapy. However, studies have shown that clinicians frequently underestimate symptom severity, even when patients have been seen recently in the office.¹⁵ Families also tend to underestimate severity, and often describe their child's asthma as being under "good control", even when the child is experiencing daily symptoms.¹⁶⁻¹⁸ Inaccurate symptom assessments are likely an important contributing cause to inadequate preventive therapy. Importantly, systematic screening methods for asthma assessments¹⁹⁻²² have not been widely incorporated into office visits.

We sought to evaluate several methods of unstructured severity assessments for childhood asthma that likely approximate methods used in busy primary care practices.

We used the standard NAEPP severity classifications as our gold standard, and administered three additional unstructured methods of assessment based on parent report.

The objectives of this study were to interview a diverse sample of parents of children with asthma in order to:

- Describe the range of reported illness severity using these unstructured methods of inquiry
- Determine which method of severity assessment is least likely to result in a "critical error" that could adversely influence the child's asthma care
- Determine whether the likelihood of making a "critical error" varies by sociodemographic characteristics of the patient or family.

METHODS

Setting and participants

The University of Rochester Institutional Review Board approved the study protocol. Children (aged 5-12) with asthma and their parents were recruited from three urban clinics and three suburban practices in Monroe County, NY. All children carried a diagnosis of asthma, had ≥ 2 asthma related visits in the prior 12 months, and their families were English speaking. Children were identified using the practices' computerised datasets. Eligible families were informed of the study by a letter from the providers in each office and could refuse further contact by notifying their provider. Interested families received a home visit by experienced paediatric nurses with specific training in asthma care, informed consent and child assent were obtained, and in-depth home interviews were conducted.

Measures

Asthma severity

We evaluated clinical status during the three months prior to the interview using structured questions reflecting the NAEPP criteria for severity classification. We chose this three month time frame to provide a representative picture of the child's recent asthma experience.²³

Parents were asked to report on how many days the child experienced daytime symptoms of asthma, nocturnal symptoms, activity limitations, exacerbations, and rescue medication use. We defined children's asthma severity according to the national guideline classification system,⁴ regardless of whether they reported use of a maintenance asthma medication. This definition was used as the gold standard assessment of severity (table 1).

Unstructured assessments of severity

We determined the parents' assessments of severity using a visual analogue scale (VAS; range 0–100), a categorical assessment of severity (four levels), and a Likert scale assessment of asthma control. For the visual analogue scale, we asked parents to think about the last three months, and place an "X" along a 100 mm line to indicate the severity of the child's symptoms. Anchor statements were written on each side of the line; "no symptoms" on the left at 0, and "very bad symptoms" on the right at 100. The distance between the 0 mm mark and the placement of the "X" was measured to provide a numeric interpretation of their responses. In order to make comparisons directly to the four categories in the NAEPP assessment of severity, we collapsed this variable into quartiles (0–25, 26–50, 51–75, 76–100), with the higher numbers indicating a higher level of severity.

The categorical assessment of severity was based on a translation of the NAEPP guidelines. We asked the parent to think about their child's asthma during the past three months, and label their symptoms as "mild symptoms once in a while", "mild symptoms frequently", "moderate asthma", or "severe asthma". Lastly, we asked parents, again during the past three months, to what extent they agreed with the statement: "My child's asthma is under good control". They were asked to respond with one of the following choices: strongly disagree, disagree, don't know, agree, or strongly agree.

We determined that a parent made a "critical error" if they reported the child's symptoms in the lower 50th centile of severity for either the VAS or the categorical assessment, and the child had either moderate or severe persistent symptoms according to NAEPP classification criteria. These children clearly require additional treatment, and such an error in assessment likely would result in missed or delayed preventive care. For the control assessment, a critical error occurred when the child had moderate or severe persistent symptoms and the parent reported that they either *agreed* or *strongly agreed* that the child's asthma was under good control.

Assessment of covariates

Covariates in this study were standard demographic variables, medications, and asthma severity according to the NAEPP criteria. Demographic variables included the child's age, race (white, black, Hispanic, and other races), poverty (poor v non-poor, using Medicaid and State Children's Health Insurance Program eligibility to determine the poor subgroup), and parent education (<high school, high school graduate, or >high school). For race related subgroup comparisons, black and Hispanic subjects were combined into a "minority" category to ensure an adequate sample size. The "other" group was too small (n = 3) for meaningful contrasts and was therefore removed from analyses involving race. Maintenance medications included any preventive medication recommended by the guidelines.⁴

Analysis

We used cross tabulations and χ^2 analyses to test for differences in proportions. Since only children with moderate persistent or more severe symptoms were at risk for the *critical error* outcome, we limited comparisons regarding critical errors to that subgroup of children (n = 87). Logistic regression models were used for multivariate analysis to evaluate factors associated with a critical error, including demographic characteristics and asthma severity. We performed all analyses using SPSS software (SPSS 12.0 for Windows). A two sided alpha <0.05 was considered statistically significant.

RESULTS

Two hundred and seventy seven children were eligible based on the practices' datasets and were contacted for potential enrolment. Of these, 49 (18%) families refused, for a final study population of 228 families. Table 2 shows the demographic characteristics of the sample. Approximately half of the subjects were from minority racial backgrounds, and 45% were poor. Thirty five per cent of the children were cared for in clinic practices and 14% of parents had less than a high school education.

Using the NAEPP classification of asthma severity, all levels of symptom severity were represented (24% mild intermittent, 38% mild persistent, 24% moderate persistent, and 14% severe persistent). Children from minority racial backgrounds were overrepresented in the moderate to severe persistent category (White, 28%; Black, 52%; Hispanic, 33%; $p < 0.001$). Similarly, a greater proportion of poor children, children whose mothers had a lower education level, and children from the clinic practices had moderate to severe persistent symptoms compared to children in the lower risk subgroups. Overall, 59.6% reported the use of a maintenance medication, with more common use among those children with more severe symptoms. However, 28.7% of children with the greatest level of severity reported no use of maintenance medications.

Table 1 Clinical features to establish severity based on NHLBI criteria*

Feature	Mild intermittent	Mild persistent	Moderate persistent	Severe persistent
Frequency of symptoms	Symptoms ≤ 2 times a week	Symptoms > 2 times a week, but not daily	Daily symptoms	Continuous symptoms
Limitations on physical activity	No limitations on activity between exacerbations	Exacerbations may affect activity	Exacerbations affect activity	Limited physical activity
Exacerbations	Brief and infrequent	Occasional	2 exacerbations per week; may last days	Frequent exacerbations
Use of short acting β_2 agonist	Rarely	Occasional	Daily	Frequent
Nocturnal symptoms	≤ 2 times a month	> 2 times a month	> 1 time a week	Frequent

*The presence of one of the features of severity is sufficient to place a patient in that category.

Table 2 Population demographics by asthma severity (Total n=228)

Demographic characteristic	Whole sample		Mild intermittent %	Mild persistent %	Moderate-severe persistent %	p value
	n	%				
Race						
White	123	53.9	36.6	35.0	28.5	<0.001
Black	84	36.8	9.5	38.1	52.4	
Hispanic	18	7.9	11.1	55.6	33.3	
Other	3	1.3				
Age of child						
5-8 y	98	43.0	24.5	39.8	35.7	0.79
9-12 y	130	57.0	23.8	36.2	40.0	
Poor/non-poor						
Poor	103	45.2	12.6	37.9	49.5	<0.001
Non-poor	125	54.8	33.6	37.6	28.8	
Clinic/private practice						
Clinic	79	34.6	7.6	38.0	54.4	<0.001
Private practice	149	65.4	32.9	37.6	29.5	
Educational level of mother						
<High school	31	13.6	3.2	38.7	58.1	0.02
High school	68	29.8	25.0	33.8	41.2	
>High school	129	56.6	28.7	39.5	31.8	
Maintenance medication use						
No	92	40.4	50.9	43.3	28.7	0.02
Yes	136	59.6	49.1	54.7	71.3	
Symptom severity of child						
Mild intermittent	55	24.1				
Mild persistent	86	37.7				
Moderate	55	24.1				
Severe	32	14.0				

Table 3 shows the parent's report of the child's symptom severity using the three unstructured assessment methods described above. For all methods of assessment, the majority of parents rated their child's severity in the lower 50th centile (more mild), with fairly similar distributions with each method. Overall, 36% of parents described their children as having symptoms in the lowest quartile (0-25) using the VAS, and 35% chose the second lowest quartile (26-50). For the categorical assessment, 58% of parents chose the mildest category. More than three quarters of parents agreed or strongly agreed that the child's asthma was under good control.

Table 3 also shows the unstructured assessments of severity compared to the NAEPP classification of severity. Very few parents of children with mild intermittent asthma overestimated their symptom severity by choosing high levels (in the upper 50th centile) of severity by the VAS (0%), the categorical method (2%), or the classification of asthma

control (4%). Children with higher severity as defined by NAEPP criteria were rated as more symptomatic on each unstructured assessment method compared to those with less severe symptoms ($p = 0.001$). However, among the children with moderate to severe symptoms, 41% of parents rated their children in the lowest two quartiles using the VAS assessment (0-50) and thus would be defined as having a "critical error". For the categorical assessment, 45% of parents of children with moderate to severe persistent symptoms made a critical error and chose the two mild categories, and 67% strongly agreed or agreed that their child's asthma was under good control.

We next considered the probability of parents making a "critical error" in their severity assessment by demographic characteristics, asthma severity, and preventive medication use. For these analyses, we used the VAS, since this measure was the least likely to result in a critical error in the overall analysis. Among the 87 children with moderate to severe

Table 3 Unstructured assessments of severity by NHLBI professional assessment

	Whole sample (all severity levels) n = 228		Mild intermittent n = 55 %	Mild persistent n = 86 %	Moderate-severe persistent n = 87 %	p value
	n	%				
Parent VAS						
0-25	83	36.4	76.4	39.5	8.0	<0.001
26-50	80	35.1	23.6	44.2	33.3	
51-75	42	18.4	0	14.0	34.5	
76-100	23	10.1	0	2.3	24.1	
Parent category						
1: mild symptoms once in a while	131	57.5	94.5	67.4	24.1	<0.001
2: mild symptoms frequently	40	17.5	3.6	23.3	20.7	
3: moderate asthma	46	20.2	1.8	9.3	42.5	
4: severe asthma	11	4.8	0	0	12.6	
Parent good control						
Strongly agree/agree	190	83.3	96.4	91.9	66.7	<0.001
Not sure	16	7.0	1.8	3.5	13.8	
Strongly disagree/disagree	22	9.6	1.8	4.7	19.5	

persistent asthma, there were no differences in the likelihood of making a critical error by demographic characteristics, practice type (clinic v private practice) or use of maintenance medications (table 4). There was a trend for parents of children with severe persistent symptoms to be less likely to make a critical error compared to parents of children with moderate persistent symptoms (28% v 49%, $p = 0.056$). In a multivariate logistic regression including *critical error* as the dependent variable, and race, poverty, and severity level as the independent variables, none of the independent variables predicted the presence of a critical error.

DISCUSSION

This study compared several different methods of asthma severity reporting by parents. Using a structured method based on NAEPP guidelines, parents were able to report on their child's symptoms to allow for appropriate severity classification. We found that all of the unstructured methods of assessment underestimate severity levels compared to the NAEPP professional standards. Parents described a higher level of severity for those children with persistent symptoms based on NAEPP criteria; however, many children in the severe categories were still described as having relatively mild symptoms. The method least likely to produce a critical error in severity assessment was the VAS, which is relatively simple to use, and is familiar to many providers and families because it is commonly used for pain assessments.^{24 25} However, even with this method of assessment, the likelihood of a critical error was close to 50%.

The likelihood of a critical error using the VAS did not vary by the family demographic characteristics or the use of preventive medications. However, children from poor and minority backgrounds were more likely to have moderate to severe persistent symptoms, and thus represent a large proportion of the group for whom a critical error was possible. This is particularly pertinent since inadequate preventive therapy is common among poor urban children.^{11–15} Further, while parents of children with severe persistent symptoms were slightly less likely to make a critical error in their assessment compared to parents of children with moderate persistent symptoms, the children

with severe symptoms have *continual* symptoms per the NAEPP definition, and still more than 25% were categorised in the lower 50th centile of severity.

Consistent with prior studies,^{16–18} we showed the parent's assessment of the child's symptom control in general to yield the greatest discrepancy from the professional model assessment of severity. The vast majority of parents of children in any severity level stated that they agreed their child's asthma was under good control. While severity and control are now considered to be distinct concepts, a greater understanding of parent's interpretation of this question and a shared understanding between parents and providers of what "good control" represents may help to improve assessments in the future.

Prior studies have shown that poor perceptual accuracy in asthma is common, with both adults and children frequently underestimating symptom severity as compared to objective measures of pulmonary function.^{26–30} Poor symptom perception may play a role in overall functional impairment and morbidity due to asthma.^{31–33} The current study compared unstructured symptom assessment tools to the professional standard for symptom reporting, rather than to objective measures of lung function, and it is not surprising that the data yielded similar findings. Symptom reporting by parents provides the basis for clinical decision making in childhood asthma. A child whose persistent asthma symptoms go unrecognised by a clinician may be missing significant opportunities for health care counselling, education, medication prescription or adjustment, and referrals as appropriate.

The reasons for discrepancies in parent assessments of asthma severity are not clear. Parents may be accustomed to their child experiencing a certain degree of symptoms, and may not identify persistent symptoms as being particularly severe. Additionally, families may be experiencing many other stresses in their lives that overshadow the child's asthma symptoms. Further, providers may not be clarifying treatment goals with families, and thus their expectations about frequency of symptoms may be quite different from the professional standards.

There are some potential limitations to this study. We obtained symptom information by parent report, and did not have objective measures of lung function. However, the national guideline severity categories rely on parent report of symptoms, and therefore our definitions are consistent with this standard. Since families were recruited from primary care offices, all of the children in the study had a medical home and were under the care of a provider. These families may be more in-tune with asthma symptoms and management compared to families with poor access to health care services. Lastly, our assessment of control was based on a single, general question. While guidelines^{4 5} recommend structured assessments of severity and control, we do not know how often unstructured assessments are used in clinical practice. Several tools are now available for structured measurement of asthma control^{19–22} and likely would yield more appropriate estimates of children's symptom experience and functional outcomes.

Implications

While any of the unstructured methods of assessment tested for in this study might be useful for monitoring symptoms over time, clearly caution must be used in interpretation for initial treatment decisions. The critical errors described could prevent a child from obtaining appropriate preventive medications and from achieving optimal asthma control. It is possible that educating families and professionals about these discrepancies in assessments may help to improve asthma symptom assessments in the future.

Table 4 "Critical errors" among parents of children with moderate-severe asthma symptoms

	n	% critical error	p value
Overall	87	41.4	
Race			
Minority	35	44.0	0.37
Majority	50	34.3	
Poor/Non-poor			
Poor	51	43.1	0.69
Non-poor	36	38.9	
Educational level of mother			
<High school	18	27.8	0.20
High school	28	53.6	
>High school	41	39.0	
Maintenance medication			
Yes	62	38.7	0.43
No	25	48.0	
Age of child			
5–8 y	35	37.1	0.51
9–12 y	52	44.2	
Clinic/private practice			
Clinic	43	44.2	0.60
Private practice	44	36.8	
Asthma severity			
Moderate persistent	55	49.1	0.056
Severe persistent	32	28.1	

What is already known on this topic

- Asthma is the most common chronic illness of childhood, and preventive care is often suboptimal
- One barrier to receiving adequate asthma care is inaccurate estimations of symptom severity

What this study adds

- Unstructured methods of symptom assessment for asthma yield significant underestimations of severity compared to professional standards
- These underestimations of severity could prevent a child from obtaining appropriate preventive medications and achieving optimal asthma control

ACKNOWLEDGEMENTS

We thank Kathleen Lynch, BA for her help with manuscript preparation.

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Funding: the research for this article was funded by a grant from the National Institute of Nursing Research (1R01NR007905-01A2) and the Robert Wood Johnson Foundation's Generalist Physician Faculty Scholar's Program

Competing interests: none declared

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