Relationship of Adherence to Pediatric Asthma Morbidity Among Inner-City Children

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ABSTRACT. *Objectives.* **Morbidity from asthma among children is one of the most important US health concerns. This study examines the relationship of baseline nonadherence to subsequent asthma morbidity among inner-city children.**

Methods. **A multisite, prospective, longitudinal panel study was conducted of 1199 children who were aged 4 to 9 years and had asthma and their caregivers, most of whom were parents, in emergency departments and clinics at 8 research centers in 7 US metropolitan inner-city areas. Nine morbidity indicators were collected at 3, 6, and 9 months after baseline, including hospitalizations, unscheduled visits, days of wheeze/cough, and days of reduced activities.**

Results. **Children whose caregivers scored high on a new measure, Admitted Nonadherence, experienced significantly worse morbidity on 8 of the 9 measures. Children who scored high on a new Risk for Nonadherence measure experienced significantly worse morbidity on all 9 morbidity measures. Multiple and logistic regressions found that the adherence measures had independent significant effects on morbidity. Combining the measures improved estimates of morbidity: children whose caregivers were poor on either adherence measure had worse morbidity than those with good adherence on both, eg, rate of hospitalization was twice as high, they missed more than twice as much school, had poorer overall functioning, and experienced more days of wheezing and more restricted days of activity.**

Conclusions. **Risk for Nonadherence and Admitted Nonadherence independently and jointly predicted subsequent asthma morbidity. Targeting risks for nonadherence may be an effective intervention strategy. Most risks can be controlled by physicians through reducing the complexity of asthma regimens, communicating effectively with caregivers about medication use, and correcting family misconceptions about asthma medication side effects.** *Pediatrics* **2002;110(1). URL: http://www.pediatrics.org/cgi/content/full/110/1/e6;** ***adherence, asthma, morbidity, inner-city, child.***

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ABREVIATIONS. ED, emergency department; BSI, Brief Symptom Inventory; SD, standard deviation.

During the past 2 or 3 decades, a significant increase in morbidity and mortality has made asthma one of the most important US health concerns.[1–3] Children, particularly inner-city children, bear a disproportionate burden of asthma morbidity and mortality.[4,5]

The National Cooperative Inner-City Asthma Study was initiated to identify the factors associated with asthma morbidity in inner-city children, including exposure to environmental irritants and allergens, access to quality asthma care, psychological and social characteristics, and degree of adherence to medical regimens. This article examines the effect of adherence on asthma morbidity among inner-city children.

The successful management of pediatric asthma depends in part on the extent to which caregivers and children follow the prescribed home treatment program. Guidelines for asthma care recommend avoidance of allergen/irritant exposure, regular use of preventive medications, and an action plan with rescue medications to deal with problems when they arise.[6] The consequences of nonadherence may include poor symptom control, excessive β-agonist use, high emergency department (ED) utilization, hospitalization, and even death.[7–10]

Levels of adherence for asthma vary from 3% to 88%[11–20] and are unrelated to age, race, or gender. Most of the literature is compliance-focused and assumes that the patient is the problem.[20] However, data suggest that nonadherence is less dependent on individual patient characteristics than it is on the disease itself, the pharmacologic properties of the medications used, the complexity of the regimen, and patient–provider interaction.[5,21,22] Factors associated with lower adherence to the medical regimen include lack of efficacy of the medication (real or perceived); omission or drug overdose; medication taste; too many medications with multiple dosing intervals; long, demanding, or stressful treatment regimens; and incorrect prescriptions given by clinicians.[5,22,23] Patient-related factors that may affect adherence include skepticism about the value of the therapy, forgetfulness, poor hearing or eyesight, decreased mental and functional capabilities, poor quality of life and morale, lack of social support, the

presence of multiple caregivers, and poor understanding of the provider's instructions.[5,21–26]

The rate of adherence in pediatric asthma is similar to that in adults.[27–35] Children may not adhere to a therapeutic program because medications make them feel strange or uneasy, taking medication makes them feel unpopular, taking medication is a nuisance (eg, it imposes activity restrictions, disrupts lifestyle, increases perceived vulnerability), they may not want to admit symptoms or the need for therapy, there may be fantasies regarding the power and danger of drugs (risks, side effects), and the cost may be prohibitive.[19,23,36] Full adherence is more likely when the child and the caregiver perceive the child as vulnerable to the disease or its complications, complications of the disease are viewed as serious, and there are anticipated benefits from following the treatment program.[19]

Although several objective strategies have been used to assess adherence, all have shortcomings. Microprocessors (nebulizer chronologs, blister packs, and medication event monitors) are expensive and difficult to use with children. Measurement of medication levels in body fluids is accurate for usage only at a single moment, not continuous medication use. Much asthma therapy uses aerosols that are given in amounts that are difficult to detect. Pill counts or weighing metered-dose inhaler canisters to assess medication use can be used but are subject to falsification through "dumping," ie, throwing away medication before turning in canisters/vials to make it seem that medication was taken appropriately. Other objective measures, such as keeping office appointments, may not occur often enough to provide valid indicators of adherence.

Self-report measures of adherence are most commonly used in research because they are simple, fast, noninvasive, and relatively inexpensive. They can also measure adherence to aspects of a medical management program other than medication usage, such as appointment keeping, avoidance of known asthma triggers, and the use of an emergency plan of action for acute asthma events. The major criticism of patient self-reports is the vulnerability to social desirability bias, in which patients or caregivers overreport adherence to their regimen. Validity is a major problem with this approach even with well-established instruments of self-report.[37,38] The lack of a simple and accurate measure has been a major barrier to research in the area of adherence.[21]

Because there are no "gold standard" objective measures of adherence and because patient self-reports of adherence may overestimate adherence, we sought to develop ways of measuring adherence other than questions that would require admitting nonadherence. This article presents 2 new measures of adherence of families to pediatric asthma regimens: "Admitted Nonadherence" and "Risk for Nonadherence." Using these 2 measures, we describe characteristics of families that admit nonadherence and that are at increased risk for nonadherence, and report how these 2 adherence measures were related to asthma morbidity.

METHODS

Sample Recruitment and Procedures

We recruited 1528 children with asthma and their caregivers from EDs and clinics at 8 research centers in 7 metropolitan inner-city areas in the United States. All children were 4 to 9 years of age and met the standard definition of asthma.[39] Participants had to be English or Spanish speaking. Data were collected by trained interviewers in a 2.5-hour baseline interview. Content of the interview included exposure to environmental allergens, psychosocial data (eg, child and caregiver mental health, social support, parenting), current treatment regimen and adherence to it, access to a regular provider for asthma care, and morbidity from asthma. Caregivers were subsequently interviewed by telephone 3, 6, and 9 months after baseline assessment to measure ongoing asthma morbidity. Detailed information about the study sample and procedures is available elsewhere.[39] Follow-up data were available for 1199 children. Studies were approved by each site's Institutional Review Board, and informed consent was obtained from caregivers.

Measures

Two new adherence measures were developed for this study. Admitted Nonadherence was developed because there are many kinds of potential nonadherence with medical regimens for asthma, only some of which include medication misuse or nonuse. The measure is a summary score of the number of times that caregivers admitted noncompliance with a physician recommendation for asthma management. We assessed approximately 9 potential recommendations: medication administration (eg, gives more or less medication than prescribed, did not fill a prescription); allergen exposure (eg, did not use mattress cover); and others (eg, did not obtain prescribed peak flow meter; see Table 1 for complete list). This measure requires that caregivers report that a specific recommendation was made by a physician and that they did not follow it. Therefore, it is vulnerable to social desirability bias.

The second measure, Risk for Nonadherence, was based on the existing literature on nonadherence. It is a summary score of characteristics of a child's regimen and characteristics of the caregiver or the child that previous research had demonstrated to be associated with nonadherence. This measure does not require that caregivers admit nonadherence; therefore, it is less vulnerable to social desirability bias. The measure consists of 12 factors, including risks for nonadherence as a result of regimen complexity (eg, takes >1 prescription drug for asthma, takes >1 medication at a time) and family characteristics (eg, worries that the child gets too much medicine, worries about side effects, feels medicines are only somewhat useful, presence of multiple caregivers).

Nine indicators of asthma morbidity were measured at 3, 6, and

TABLE 1. Admitted Nonadherence

Item	*N*	%
Did not fill a prescription	195	16.3
Gives less medicine than prescribed	184	17.6
Gives more medicine than prescribed	119	11.4
Did not obtain recommended		
Vaporizer	105	11.7
Nebulizer	87	8.8
Dehumidifier	76	6.9
Peak flow meter	56	4.8
Air cleaner	50	4.4
Mattress cover	36	3.2
Number of admitted non adherence items		
0	629	52.5
1	344	28.7
2	150	12.5
3	53	4.4
4	14	1.2
5	5	0.4
6	4	0.3

We included all physical recommendations even though some experts believed that they were not effective asthma treatments (eg, vaporizers) because parents were expected to adhere to these recommendations.

9 months after the baseline interview. For each 3-month window, caregivers reported number of asthma hospitalizations, number of unscheduled visits for asthma (including provider and ED visits), and number of school days missed as a result of asthma. At each of the 3 follow-up interviews, caregivers also reported, for the 2 weeks before the interview, the number of days of wheeze/cough, the number of days the child had to reduce usual activities, the number of days the caregiver had to change plans as a result of asthma symptoms, and the number of nights the child and/or caregiver awoke as a result of asthma symptoms. Scores for days of wheeze, school days missed, days of reduced activity, and caregiver or child woke up were averaged over the valid data points. Data on hospitalization, doctor visits, and ED visits were added and dichotomized into "none" or "any." In addition, we used a modified version of the Functional Status II.[40] This tool assesses the degree to which illness contributes to reduced daily functioning in specific ways (eg, physical exercise, eating, sleeping). The 14 items are rated on a 5-point scale (modified from the original 3-point scale). Scores range from 0 to 100, with higher scores meaning better functioning.

Because morbidity from asthma can manifest itself in different ways, we combined morbidity experiences from asthma into a summary score. However, most of the correlations among morbidity measures were low to moderate, ranging from −0.10 to 0.59 (except the correlation of child and caregiver awaking as a result of symptoms, which was 0.83). To create a summary variable of the intensity and variety of children's morbidity experiences, we dichotomized each of the 9 morbidity measures at the median and defined a score in the top 50th percentile as "serious." We then summed the number of serious morbidity consequences that each child experienced. This resulted in a summary morbidity measure that we call "Overall Severity of Morbidity Experience," with a potential range of 0 to 9. We also created a Baseline Asthma Severity measure using the baseline morbidity items, following the same process as the Overall Severity of Morbidity Experience.

Because adherence might be influenced by caregiver or child mental health, we included measures of these in this analysis. Child mental health was measured using the Child Behavior Checklist,[41] a 118-item checklist completed by the caregiver. Higher scores mean more behavioral and emotional problems. Caregiver mental health was measured using the Brief Symptom Inventory (BSI),[42] a 53-item tool completed by the caregiver, that measures psychological symptoms. Higher scores indicate more distress.

Plan of Analysis

Mean outcome measures were examined by level of Admitted Nonadherence or Risk for Nonadherence using analysis of variance. Results from χ^2 analysis are reported for categorical outcomes (hospitalization and unscheduled asthma visits). Multiple and logistic regression were used to examine these outcomes, controlling for baseline characteristics (age and gender of child, caregiver's education and income, maternal and child mental health). To examine whether the observed differences in adherence were attributable to the child's asthma severity, we examined the outcomes separately in the "more severe" and "less severe" groups.

RESULTS

There were no significant differences in race/ethnic background, age, gender, income level, caregiver's education, and child behavior problems between those with valid data and those with missing data (primarily morbidity outcome data). Those excluded from the analysis as a result of missing data were more likely to demonstrate caregiver mental health problems (BSI above the clinical cutoff). We also excluded children with undiagnosed asthma. Background characteristics of the study sample are presented in Table 2. As intended, the National Cooperative Inner-City Asthma Study sample reflected a poor, inner-city minority population of families. Data on average asthma morbidity experienced during the 9 months after baseline are also presented in Table 2. Children on average experienced significant levels of asthma symptoms and health care utilization, with an average of 3.5 days of wheeze per 2-week period and 2.0 days of reduced or limited activity. During the 9-month follow-up period, 13% of children were hospitalized and more than half had at least 1 visit to the ED or their provider for an acute asthma episode. The Baseline Asthma Severity Score was 3.8 (standard deviation [SD]: 2.4).

TABLE 2. Description of Study Sample

	N	%	Mean	SD
Demographic characteristics	1199			
Income (% under $15 000)	645	60.2		
Child gender (% male)	749	62.5		
Race/ethnicity				
Hispanic	245	20.4		
Black	880	73.4		
White	10	0.8		
Other	64	5.3		
Mother's education (% high school graduate)	796	66.4		
Child age (mean years)			6.2	1.7
Baseline severity of morbidity score			3.7	2.4
Medication regimen				
No medications	145	12.1		
β-agonists only	435	36.3		
Preventive medication	619	51.6		
9-mo morbidity				
Days of wheeze/14 d			3.5	2.8
Days slowed activity/14 d			2.0	2.3
Nights child woke/14 d			1.8	2.3
Nights caregiver woke/14 d			2.2	2.7
Days caregiver changed plans/14 d			2.7	5.4
Functional status score			79.4	14.5
School days missed/100 d			6.5	7.5
Ever hospitalized/9 mo	156	13.0		
Any unscheduled asthma visit/9 mo	657	54.8		
Overall Severity of Morbidity score			3.8	2.8

TABLE 3. Risk for Nonadherence

Item	*N*	%
Has >1 prescribed medicine	729	60.8
Takes >1 medicine per day	655	54.6
Worry about medication side effects	582	48.5
Multiple asthma caregivers (child plus 3+ others)	489	40.8
Takes medicines for other problems	445	37.1
Worries child gets too much medicine	386	32.2
Feels medications are only somewhat useful	384	32.0
Worries child does not get enough medicine	239	19.9
Has trouble getting appointment	184	15.3
Has problems giving medications	174	14.5
Does not have medication in the house if needed	167	13.9
Child refuses medications	82	6.8
Number of adherence risk factors		
0	46	3.8
1	113	9.4
2	169	14.1
3	229	19.1
4	223	18.6
5	185	15.4
6	126	10.5
7	73	6.1
8	23	1.9
9	10	0.8
10	2	0.2

Admitted Nonadherence

Table 1 describes how often caregivers reported that they adhered to physician recommendations for asthma management. Each type of nonadherence was admitted rarely. The most common kind of nonadherence, not filling a prescription, was reported by <20% of caregivers. However, overall, 47.5% of caregivers admitted that they did not adhere to at least 1 medical recommendation, with a mean of 0.76 (SD: 1.01). For purposes of additional analysis, we collapsed the Admitted Nonadherence measure into 3 groups: low (no admission of nonadherence, 52.5%, $n = 629$), medium (1 instance of nonadherence admitted, 28.7%, $n = 344$), and high (>1 instance of nonadherence admitted, 18.8%, $n = 226$). We examined the relationship of family characteristics, including child and caregiver mental health, with Admitted Nonadherence. No background characteristic was significantly related, ie, admitted nonadherence was just as likely among boys and girls, younger and older children, Hispanics and blacks, better or more poorly educated mothers, and families above and below the poverty line. However, there was a statistically significant relationship between poorer mental health of the caregiver and more admitted nonadherence: 42% of caregivers who denied nonadherence had BSI scores indicating symptom levels that were clinically significant, compared with 50.6% of mothers who admitted 1 kind of nonadherence, and 58.0% of caregivers admitting >1 kind of nonadherence ($P < .05$).

Risk for Nonadherence

Risk factors for nonadherence are listed in Table 3, along with the total summary score on the Risk for Nonadherence measure. Risk factors for nonadherence were much more common than admissions of nonadherence. The 7 most frequently reported risk factors were all medication-related (eg, child takes >1 prescription medication; child takes >1 medication at a time, caregiver worries about medication side effects, child takes medications for other problems as well as asthma). Overall, caregivers averaged 3.8 (SD: 1.97) risks for nonadherence, and only 3.8% of families had no risk factors. Risk for Nonadherence was grouped into 3 categories: low risk (0–2 risk factors, 27.4%), medium risk (3–4 risk factors, 37.7%), and high risk (5 or more risk factors, 34.9%; $P < .001$).

We tested whether characteristics of children and caregivers were related to Risk for Nonadherence. Risk for Nonadherence scores were significantly higher among boys (in the low-risk group, the percentage of boys was 56.7%, vs 62.8% for medium risk and 66.6% in high risk; $P = .021$). Both child and caregiver mental health were related to Risk for Nonadherence. The proportion of caregivers with clinically significant mental health problems was 42.4% among those at low risk, 46.5% among those at medium risk, and 53.7% among those at high risk ($P < .01$). The proportion of children with clinically significant psychological symptoms among those at low risk was 27.7%, compared with 30.8% at middle risk and 37.2% at high risk ($P < .02$).

TABLE 4. Relationship of Admitted Nonadherence and Risk for Nonadherence to Morbidity

	Admitted Nonadherence					Risk for Nonadherence			
	Total ($n = 1199$)	Low ($n = 629$)	Medium ($n = 344$)	High ($n = 226$)	*P* Value*	Low ($n = 328$)	Medium ($n = 452$)	High ($n = 419$)	*P* Value*
Days of wheeze/14 d	3.5	3.1	3.8	4.0	<.001	3.0	3.4	3.8	<.001
Days slowed activity/14 d	2.0	1.7	2.0	2.7	<.001	1.4	1.9	2.4	<.001
Nights child woke/14 d	1.8	1.6	1.7	2.4	<.001	1.2	1.7	2.2	<.001
Nights caregiver woke/14 d	2.2	2.0	2.1	3.0	<.001	1.6	2.2	2.7	<.001
Days caregiver changed plans/14 d	2.7	2.1	2.8	4.6	<.001	1.7	2.4	3.9	<.001
Functional status score	79.4	81.0	79.3	74.8	<.001	82.7	79.9	76.3	<.001
School days missed/100 d	6.5	5.4	6.8	8.9	<.001	4.2	6.5	8.1	<.001
Ever hospitalized/9 mo	13.0	11.0	14.2	16.8	.059	7.3	13.3	17.2	<.001
Any unscheduled asthma visit/9 mo	54.8	49.4	56.1	67.7	<.001	39.9	57.5	63.5	<.001
Overall Severity of Morbidity score	3.8	3.2	3.9	5.0	<.001	2.8	3.8	4.5	<.001

* *P* values from analysis of variance, except for hospitalization and unscheduled visits, which are χ^2 *P* values.

TABLE 5. Effect of Risk for Nonadherence on Morbidity by Baseline Severity

Risk for Nonadherence* as a Predictor of	Less Severe		More Severe	
	Coefficient (OR)	*P* Value	Coefficient (OR)	*P* Value
Days of wheeze/14 d	0.08	.210	0.08	.209
Days slowed activity/14 d	0.09	.027	0.16	.002
Nights child woke/14 d	0.08	.025	0.15	.010
Nights caregiver woke/14 d	0.10	.025	0.16	.016
Days caregiver changed plans/14 d	0.20	<.001	0.46	.002
Functional status score	−0.65	.016	−0.85	.006
School days missed/100 d	0.54	<.001	0.48	.014
Ever hospitalized/9 mo†	1.16	.095	1.16	.010
Any unscheduled asthma visit/9 mo†	1.15	.003	1.11	.022
Overall Severity of Morbidity score	0.26	<.001	0.14	.010

OR indicates odds ratio.
* Controlled for gender, BSI, and Child Behavior Checklist.
† Logistic regression; reported odds ratios.

Relationship of Risk for Nonadherence and Admitted Nonadherence

Risk for Nonadherence and Admitted Nonadherence were significantly related, but the Pearson correlation was weak ($r = 0.24$; $P < .0001$). The more risk factors for nonadherence there were, the more likely it was that the caregiver admitted nonadherence.

Relationship of Adherence Measures to Subsequent Asthma Morbidity

Both adherence measures were related to each of the 9 kinds of asthma morbidity examined Table 4 (except Admitted Nonadherence and hospitalization, where $P = .059$). Compared with children of caregivers who denied nonadherence, children whose caregivers scored high on Admitted Nonadherence, for example, experienced 1 extra day of wheezing (4.0 vs 3.1) and 1 extra day of limited activity (2.7 vs 1.7) per 2-week period. Children whose caregivers were low on Admitted Nonadherence experienced 3.2 kinds of serious morbidity on the Overall Severity of Morbidity measure compared with 5.0 kinds of serious morbidity among those high on Admitted Nonadherence.

The Risk for Nonadherence measure had similar significant effects. Children with many risk factors experienced 0.80 more days of wheeze and 1 more day of activity restriction as a result of asthma compared with children with few risks for nonadherence. Children with few risks experienced on average 2.8 types of serious morbidity on the Overall Severity of Morbidity measure compared with 4.5 types of serious morbidity among children with many risks for nonadherence.

Because of this finding, we undertook an additional analysis to rule out the possibility that the Risk for Nonadherence scale might be confounded with asthma severity. Because risks for nonadherence include indicators of complexity of medical regimen, and complexity of regimen might be related to severity of asthma, it could be that children whom we called "high" on the Risk for Nonadherence scale were simply more seriously ill children. However, when we repeated this analysis within groups of children with low Baseline Asthma Severity Scores (those below the median of 4) and high baseline Asthma Severity Scores (those at or above the median of 4), the pattern of findings remained the same (Table 5), ie, Risk for Nonadherence and Admitted Nonadherence both were related to increased morbidity regardless of the severity of illness.

Independent Effects of Admitted Nonadherence and Risk for Nonadherence

Both adherence measures demonstrated effects on morbidity but were only weakly correlated with each other. Therefore, we tested the hypothesis that each of these measures would have independent effects on morbidity when the other (and background factors) was controlled. Multiple regressions were performed, controlling for background characteristics and child and caregiver mental health, for continuous morbidity measures, and logistic regression was performed for the 2 dichotomized variables. In all but 1 case, each measure maintained its separate effect on morbidity when the other was controlled. The exception—that hospitalization for asthma was significantly related only to Risk for Nonadherence, not Admitted Nonadherence—was the same as found in the bivariate analysis.

Because both adherence variables were independently related to morbidity, we created a typology using the 2 measures together to determine whether we could improve our prediction of asthma morbidity. We developed a new 3-group typology of adherence (Table 6): 1) good adherence was defined as low risk for nonadherence and no or only 1 type of ad-

TABLE 6. Is Admitted Nonadherence Related to Risk for Nonadherence?*

Admitted Nonadherence	Risk for Nonadherence			
	Low	Medium	High	Total
Low (0)	216†	256‡	157§	629
Medium (1)	77‡	124‡	143§	344
High (2+)	35§	72§	119§	226
Total	328	452	419	1199

* χ^2 *P* value <.001; Pearson $r = 0.238$ ($P < .0001$).
Adherence typology: † good; ‡ medium; § poor.

TABLE 7. Relationship of Adherence Typology to Morbidity

	Total (n = 1199)	Adherence Typology			P Value*
		Good (n = 216)	Medium (n = 457)	Poor (n = 526)	
Days of wheeze/14 d	3.5	2.6	3.4	3.9	<.001
Days slowed activity/14 d	2.0	1.2	1.8	2.4	<.001
Nights child woke/14 d	1.8	1.2	1.5	2.2	<.001
Nights caregiver woke/14 d	2.2	1.4	1.9	2.8	<.001
Days caregiver changed plans/14 d	2.7	1.3	2.0	4.0	<.001
Functional status score	79.4	84.1	80.8	76.2	<.001
School days missed/100 d	6.5	3.4	5.9	8.1	<.001
Ever hospitalized/9 mo	13.0	6.0	12.5	16.4	<.001
Any unscheduled asthma visit/9 mo	54.8	35.2	53.6	63.9	<.001
Overall Severity of Morbidity score	3.8	2.4	3.4	4.6	<.001

* P values are analysis of variance, except for hospitalization and unscheduled visits, which are from logistic regression. Significance is controlled for the effects of child gender, child caregiver mental health, and number of medications. Unadjusted means and proportions are presented.

mitted nonadherence (18%, n = 216); 2) medium adherence was defined as medium on 1 or both measures and not poor adherence on either one (38.0%, n = 457); and 3) poor adherence, poor on either adherence measures (43.9%, n = 526). All morbidity measures were strongly related to the adherence typology (Table 7). Furthermore, when caregivers were classified as having good adherence, their children had almost half as much serious morbidity as caregivers who were rated as poor adherers (x = 2.4 vs 4.6; $P < .001$).

DISCUSSION

Among these inner-city children with asthma, asthma morbidity was high. Symptoms of wheeze and cough, night waking, and missed school were common. Most children had at least 1 urgent visit for asthma during a 9-month period (which included the summer months), and 13% were hospitalized for asthma during that time.

Few caregivers admitted nonadherence to physician recommendations, but risk factors for nonadherence were common in this sample. Most often, risk factors related to medication use, such as fear of side effects or giving too much medication. Both Admitted Nonadherence and Risk for Nonadherence measures were related to morbidity: the more instances in which families admitted to nonadherence, the worse the morbidity, and the more risk factors for nonadherence a child had, the worse the child's morbidity. Furthermore, both adherence measures were independently associated with morbidity, with Risk for Nonadherence more strongly related to morbidity indicators than Admitted Nonadherence. Both Risk for Nonadherence and Admitted Nonadherence were important predictors of morbidity in those with less severe and more severe asthma.

Because social desirability may reduce the likelihood that people will actually admit to nonadherence, we believe that Admitted Nonadherence is a biased measure that overestimates adherence. Although Risk for Nonadherence seems to be a better predictor of subsequent morbidity than Admitted Nonadherence, together these 2 measures independently and jointly predicted subsequent morbidity during the following 9 months. For example, risk of hospitalization was more than twice as high among children whose caregivers were high on either adherence measure. They missed more than twice as much school, had poorer overall functioning, and experienced more days of wheezing and more restricted days of activity.

Reducing risks for nonadherence may be an effective intervention strategy. Most risks for nonadherence that appear in the Risk for Nonadherence scale can be controlled or influenced by physicians through reducing the complexity of the asthma regimen, by communicating effectively with caregivers about medication use, and through identifying and dealing with patient/family misconceptions about asthma medication side effects.

Both measures, Admitted Nonadherence and Risk for Nonadherence, seem to be promising tools to assess adherence in pediatric asthma using caregiver self-report. Despite the biases inherent in subjective reports of adherence and the likelihood of overreporting adherence, these 2 measures independently predict subsequent asthma morbidity. Until an objective measure of adherence is available, these 2 measures may be useful to those who study asthma morbidity in children. They may also help clinicians identify patients who are in need of more intensive assistance in adhering to medical regimens for pediatric asthma. However, neither tool has been validated as a screening tool, and additional research is warranted to examine the utility of these measures for identifying individual children for whom adherence may be problematic for clinical intervention.

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