Pediatric Asthma Management in the Family Context: The Family Asthma Management System Scale

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Objective To examine psychometric properties of a revised version of the Family Asthma Management System Scale (FAMSS), a clinical interview to assess asthma management. Methods The FAMSS was administered to 115 children with asthma and their primary caregivers, along with a measure of asthma morbidity. A subset of families (n = 53) participated also in objective-adherence monitoring and completed measures of asthma knowledge and self-efficacy. Results The FAMSS demonstrated good internal consistency (α = .84). The FAMSS summary score was unrelated to age, gender, race, or minority status, but was related to socioeconomic status (SES) and to functional morbidity at baseline and prospectively. Convergent validity of the FAMSS was documented. The FAMSS explained additional variance in concurrent-asthma morbidity beyond self-reports or objective adherence monitoring. Conclusion The FAMSS is a valuable tool to assess family-based asthma management that addresses gaps in available assessment methodologies and holds promise for research and clinical applications.

Key words assessment; asthma; family system.

Asthma is the most common childhood chronic illness in the United States and results in substantial morbidity and health care expenditures (American Lung Association, 2000; National Institutes of Health, 1997). Over the past decade, national guidelines for asthma diagnosis and management have emphasized the active roles of patients and families in disease control. This approach implies that effective partnerships between patients, families, and providers are essential for optimal disease management, reduced morbidity, and cost savings.

Pediatric asthma is characterized by a complex and fluctuating presentation of symptoms. Symptoms may vary over time with changes in lung development, variations in allergic sensitivity, and shifting exposures to lung irritants. Children's ability to report on their symptoms may also change according to developmental level and motivation for treatment. Additionally, asthma-management recommendations can range from very simple instructions (e.g., use a quick-relief medication as needed for mild symptoms) to elaborate treatment plans including multiple measures for allergen avoidance, symptom monitoring, and frequent modifications in medication regimen (National Institutes of Health, 1997). Lastly, effective management of pediatric asthma involves the successful integration of multiple systems of care, including the family system, the health care system, and alternate care settings outside the family such as day care centers or schools (McQuaid & Walders, 2003).

How the family integrates the management of asthma into the family system, or fails to do so, has been shown to have implications for asthma outcomes. Families face challenges in distributing tasks for asthma management between parents and children, particularly during periods of developmental transition such as school entry and the onset of adolescence. Some research has indicated that adherence may be compromised when...
parents overestimate the asthma self-management skills of adolescents (Walders, Drotar, & Kercsmar, 2000). Additional work has demonstrated that verbal accounts of family asthma management are related to asthma outcomes. One recent study (Fiese & Wamboldt, 2003) assessed family strategies for asthma management through parent interviews and categorized the approaches as reactive, coordinated care, and family partnerships. These patterns were associated with concurrent and prospective indicators of medical adherence and health care use. These findings underscore the importance of characterizing the family asthma management system in providing effective care for pediatric asthma.

Because of the complexity of asthma and its treatment, it is challenging to quantify and measure family-based disease management in a systematic way, and most methods fall short of capturing the complexity of how families implement asthma management. The purpose of this article is to describe a brief clinical interview method — the Family Asthma Management System Scale (FAMSS) — that seeks to capture the multifaceted nature of asthma management and to present psychometric data concerning the reliability and validity of the FAMSS. A brief review of available assessment strategies is provided before presenting the FAMSS in detail.

Clinical Assessments

Health care providers (HCP) regularly use clinical interviews to assess patient asthma management and adherence; however, clinical interviewing is rarely performed in a systematic manner, and the value of such assessments in obtaining accurate information regarding asthma management is questionable. Research demonstrates that patients overestimate their treatment adherence (Rand & Wise, 1994). HCP cannot necessarily identify nonadherent patients, but may be more accurate identifying highly adherent patients (Finney, Hook, Friman, Rapoff, & Christophersen, 1993). Although clinical assessment may serve a useful role in tailoring treatment, this approach is dependent on interviewing skill, patient-provider relationship factors, and the scope of questions covered.

Self-Report Instruments

Patient self-report of specific management behaviors, such as medication use or peak-flow meter use, is often used to measure asthma management in clinical trials and behavioral interventions. Self-report measures are appealing and commonly used because of their low cost and ease of use. These include measures to assess asthma knowledge (Wade, Holden, Lynn, Mitchell, & Ewart, 2000), behavior problems specific to asthma (Creer et al., 1989) and asthma self-efficacy (Bursch, Schwankovsky, Gilbert, & Zeiger, 1999; Schlosser & Havermans, 1992). Measures are also available to assess functional outcomes of asthma such as quality of life and activity limitation (e.g., Asmussen, Olson, Grant, Fagan, & Weiss, 1999). Diaries of symptoms and medication use are also used.

Self-report measures may be particularly useful for collecting information regarding patient beliefs, attitudes, and experiences regarding treatment regimens (Bender et al., 2000). For specific behaviors such as medication use, however, self-reports such as asthma diaries have been shown to overestimate adherence to treatment regimens by as much as 30%, regardless of whether informants are adults (Berg, Dunbar-Jacob, & Rohay, 1998), children (Bender et al., 2000), or parents reporting for children (Gibson, Ferguson, Aitchison, & Patton, 1995). Using self-report measures may be a useful strategy for collecting information on certain aspects of the experience of having asthma. Of note, they are limited in their capacity to capture the complex range of behaviors that characterize asthma management or to detect certain behaviors for which self-reports may be influenced by social desirability, such as nonadherence.

Objective Assessments

A variety of objective methodologies are available for monitoring medication usage or peak-flow meter use. Drug levels can be measured through metabolic indicators by use of laboratory assays of bodily fluids, including serum, urine, or saliva (Rapoff, 1999). Such assays are available only to determine the usage of some less commonly used asthma medications (e.g., theophylline). Although this approach provides confirmation of medication use, factors such as diet, metabolism, and use of other medications may confound results. Various types of electronic-monitoring devices have been widely used in research settings to measure inhaler use (Bender, Milgrom, Wamboldt, & Rand, 2000; McQuaid, Kopel, Klein, & Fritz, 2003), adherence to oral asthma medications (Chung & Naya, 2000), and the use of peak-flow monitors (Burkhart, Dunbar-Jacob, Fireman, & Rohay, 2002). Although the reliability of some electronic devices has been called into question (Wamboldt et al., 1999), more recent reports have found improvements in overall engineering and device reliability (Apter, Tor, & Feldman, 2001). Devices vary the precision of the behavior that is measured. Although many devices (e.g.,
Objective methods, when used alone, do not provide any information regarding the context in which medication use (or failure to take medication) is taking place. Using only objective methods by necessity also restricts the definition of adherence to a specific behavior such as taking a certain medication or using a peak-flow meter, which fails to provide the full picture regarding other elements of adherence to the disease management plan, such as avoiding triggers, responding to symptoms, and maintaining a relationship with an HCP.

**FAMSS**

Previously, our research group published preliminary data regarding a clinical-interview method, the FAMSS, designed to assess the management of children's asthma within the family context (Klinnert, McQuaid, & Gavin, 1997). The FAMSS interview was developed to identify family strengths and weaknesses in the management of pediatric asthma across a variety of domains. The FAMSS is derived from self-management theory (Clark & Starr-Schneidkraut, 1994), yet incorporates an emphasis on the child as embedded in the family system and larger health care context (Kazak, Segal-Andrews, & Johnson, 1995). Effective asthma management is evaluated at multiple levels, including developmentally appropriate self-care behaviors of the child, consistent family approaches to symptom assessment and trigger control, and effective interactions with the health care system and additional caregivers outside the family.

The FAMSS utilizes a semistructured format, which allows family members to explain behaviors, beliefs, and attitudes toward asthma management and express the extent to which they feel burdened by the illness. Interviewers are trained to probe until sufficient information is obtained to make a rating regarding adjustment in a particular domain. Family members' reports are not necessarily taken at face value. For example, the interviewer must integrate discrepant information (e.g., a parent and child may present differing reports about medication use) to make a judgment about what is occurring in the home.

An initial report describing the FAMSS (Klinnert et al., 1997) indicated that internal consistency among the 11 subscales was high (Cronbach’s $\alpha = 91$), and excellent inter-rater reliability could be achieved for the summary score. The FAMSS summary score, together with an asthma severity score, jointly accounted for a significant proportion of the variance in predicting the functional status of children with asthma. In recent years, the FAMSS has been employed in various research protocols (Klinnert et al., in press; Walders, McQuaid, Kopel, Klein, & Fritz, 2003) and has become further refined.

The current instrument is comprised of seven original core scales, with two additional scales (Child Response to Symptoms and Exacerbations; Management by Alternate Caregivers) that can be used if appropriate for a given research protocol. The core scales (Table I) represent a range of features thought to be essential for asthma management.

| Table I. Family Asthma Management System Scale (FAMSS) Subscales and Constructs Measured |
|---------------------------------|---------------------------------------------------------------|
| FAMSS subscale (number of items) | Specifications                                                                 |
| Asthma knowledge (3)            | Knowledge of basic anatomy of asthma, including concepts of bronchoconstriction and inflammation, chronicity; knowledge of function and use of child's prescribed asthma medications |
| Symptom assessment (5)          | Awareness of basic signs of asthma exacerbation, understanding and identification of early warning signs, daily and seasonal patterns, and gradation of symptoms |
| Response to symptoms and exacerbations (3) | Appropriateness of actions taken to manage initial symptoms and acute exacerbations; evidence of symptom monitoring and implementation of action plan |
| Environmental control (5)       | Evidence and extent of exposure to environmental tobacco smoke, exposure to pets and pests, dust mite exposure (if geographically relevant), additional environmental exposures |
| Medication adherence (7)        | Availability and appropriate use of quick-relief medications; adherence to long-term controller medications |
| Collaboration with health care provider (5) | Relationship with identified care provider, including effective communication, agreement regarding treatment approach; provider follows established guidelines for management, provides action plan |
| Balanced integration of asthma and family life (5) | Balance of attention to asthma management and other developmental and family issues (e.g., school attendance, participation in extracurricular and family activities) |

Optional scales include child response to symptoms and exacerbations and management by alternate caregiver.
management, including basic knowledge regarding asthma, asthma management strategies, and the partnership between physician and family. Since the original published version, three scales (parent-child conflict, parental resources, and balance of responsibility between parent and child) have been eliminated because of restricted variability and low interrelationships with other core scales. One scale (therapeutic alliance with HCP) was eliminated as it was judged to be redundant with an existing scale (collaborative relationship with HCP). Additionally, the rating scales were revised from a 5-point range to a 9-point range to increase the potential variability and specificity of ratings.

The purpose of this article is to describe the current version of the FAMSS, including the relationships of subscales to relevant self-report and objective measures and the psychometric properties of the summary score. The relative predictive utility of the FAMSS, as compared with standard self-report measures, and an objective index of medication use will be examined. Implications for its use in research and clinical settings will be discussed.

Method
Participants

To be eligible for the study, children were required to be from 7 to 17 years of age and to have physician-diagnosed asthma for at least 6 months before study enrollment. Children with other significant pulmonary conditions (e.g., cystic fibrosis) or significant cognitive delays were not eligible. Families were recruited for participation through flyers, physician referrals, and attendance at a summer camp for children with asthma. All children were from urban or suburban areas. Participants included 115 children with asthma and the primary caretaker for their asthma. Children's ages ranged from 7 to 16 years (M = 11.5). Fifty-five percent (n = 63) of child participants were female. Most primary caregivers (71%) identified their child's racial/ethnic background as White, with the remainder described as African American/Black (18%), White Hispanic (4%), or biracial (6%). The average socioeconomic status (SES) fell within Hollingshead Level IV (Hollingshead, 1975), corresponding to technical workers and minor professionals. All SES levels were represented within the sample (Levels I = 3%, II = 15%, III = 18%, IV = 43%, V = 20%).

A subset of families (n = 53) whose children had been prescribed long-term controller medications by use of inhaler completed a larger protocol including electronic monitoring of their controller medication and self-report measures of parent asthma knowledge and child self-efficacy to manage asthma. The subgroup did not differ from the overall sample for gender (χ² = .13, ns), race (χ² = .47, ns), or age (t = .00, ns). This subset of families did have a higher proportion of children with more severe asthma (χ² = 9.14, p < .05), because they were selected to participate in the larger protocol based on the use of controller medications.

Procedures

Data were collected as part of a larger study investigating children's asthma symptom perception and family asthma management. Written parent consent and child assent were obtained in accordance with Institutional Review Board guidelines. During an initial laboratory visit, children and parents completed self-report measures. MDILogs were attached to the controller medications of any participants who had been prescribed these medications by use of metered dose inhaler (n = 53). At the end of 4 to 5 weeks of data collection, families completed a second study visit to participate in the FAMSS interview and to return MDILogs. Participants not involved in MDIlog data collection completed a similar baseline visit and also participated in the FAMSS interview approximately 5 weeks following the initial visit.

FAMSS Interview

The FAMSS is a semistructured interview. The interview may be administered directly to caregivers of young children. Older children (i.e., of school age) may be included in the interview process as additional informants. Given children assume increasing responsibility for asthma-management tasks as they approach adolescence (McQuaid et al., 2001), in this study we chose to include the child in the interview to provide fuller information regarding the range of asthma-management behaviors when the parent is not present (e.g., at school).

The interview is comprised of a series of open-ended questions that are designed to assess key areas of asthma management (Table I). For example, to begin the assessment of environmental control, the interviewer states, “There are several changes you can make in your home to help your child have fewer problems with wheezing, coughing, or shortness of breath. What have you tried (if anything)?” Participants are also asked to provide ratings, by using a 5-point Likert scale, regarding certain key content.
areas (e.g., “On a five-point scale from 1 = very uncomfortable to 5 = very comfortable, how comfortable do you feel asking your child’s doctor about asthma?”). The length of the interview varies, but generally takes approximately 45 min. In this study, all interviews were audiotaped.

**FAMSS Scales**

FAMSS interviews were rated by using a standard manual. The manual provides general instructions about rating and a series of rating guidelines for each asthma-management scale. Each asthma-management scale is given a 9-point rating, ranging from 1 (representing ineffective or harmful management) to 9 (indicating highly adaptive management). The rating manual provides elaboration and brief examples at key anchor points for each rating scale. Ratings are conducted immediately after the interview or after a review of the audiotape.

**FAMSS Training**

For this study, all interviewers and raters were trained in administration and scoring through consensus meetings with the original authors of the interview. Research staff implementing the FAMSS in various studies held regular consensus meetings. Before each meeting, an audiotape and transcript (with identifying information removed) were circulated. Staff reviewed the tape and rated the family asthma-management system across the key dimensions before the meeting. Ratings were reviewed for each scale during the meeting. When ratings differed, consensus was reached through systematic discussion of interview content. This procedure is implemented to minimize drift from standard rating procedures.

**Measures**

**FAMSS Ratings**

For this study, ratings were made for the seven core subscales of the FAMSS. In addition, given the children of the sample were school aged, the *Child Response to Symptoms and Exacerbations* scale was also rated to provide an assessment of child management when not with the family (e.g., having an exacerbation at a friend’s house), resulting in a total of eight subscale ratings. The primary interviewer rated all interviews. Additionally, a subset of audiotapes (n = 38) was rated in the context of the biweekly consensus meetings, including an additional rater from the research team of this study. Intraclass correlations were computed as an estimate of reliability between the two raters and ranged from .83 to .91 across subscales. In addition to individual scale ratings, a FAMSS summary score is computed for each family by taking a mean across all subscales.

**Asthma Severity Ratings**

Background information used to assess disease severity was obtained from parental report, including basic information regarding medications and dosing, as well as descriptive information regarding the child’s functional impairment (e.g., how many days of school were missed due to asthma in the past year?) that was obtained from a standard questionnaire. Upon review of this information, a pediatric asthma specialist assigned each child an asthma-severity rating, from 1 (mild intermittent) to 4 (severe persistent), by using National Institutes of Health (NIH) criteria (National Institutes of Health, 1997). By this method, 11.3% of children were categorized as having mild intermittent asthma, 58.8% mild persistent, 25.4% moderate persistent, and 4.4% severe persistent.

**Medication Adherence**

The MDILog electronic asthma medication monitor was used to provide an objective index of medication use for all study participants who were prescribed long-term controller medications. The MDILog is a small device that can be attached easily to inhalers and records the date and time of each MDI actuation using a computer chip. It further indicates whether medication is actually inhaled by use of a temperature-sensitive thermistor. The MDILog device performs a self-check and battery test nightly to help insure data integrity.

All families were told that medication use was being recorded. Data were collected for 4 to 5 weeks. The first three days of data were excluded to minimize potential inflation of adherence because of the novelty of the device. Procedures to quantify medication use through MDILog data collection are described in detail elsewhere (McQuaid et al., 2003).

Seventy MDILogs were initially assigned across 55 children. Four monitored medications (across 4 participants) were excluded because of device problems, and six devices (across 6 participants) were not returned due to device damage or loss. This resulted in an overall device failure rate of 6% and a device loss rate of 9%. For seven children, adherence was computed across two different inhalers. In total, two cases were excluded from the data set because of data loss from faulty devices, resulting in an overall N of 53. Within individual cases, “dumping” was defined as 10 or more actuations without inhalation in a 1-min time span. Five cases were identified with medication dumping patterns, and those specific events (i.e., “dumps”) were eliminated from individual case files.
Adherence to controller medications was calculated as total doses taken per day divided by prescribed doses per day. A “dose” was defined as an actuation that was recorded as an inhalation by the MDILog. Days that reflected greater than 100% adherence, because of additional doses recorded, were truncated to 100%, such that participants could not “make up” having missed doses in the previous day by taking additional doses. Average daily adherence was computed across the first 4 weeks of participation (excluding the first three days). If more than one medication was monitored, mean adherence was computed across medications. Average medication use for the current sample was 51% of prescribed doses (range 0–99%).

Self-Report Measures

Asthma Knowledge Questionnaire
The parent's basic factual knowledge regarding asthma was assessed by a brief self-report measure adapted from one that had been used extensively in prior studies (Fitz Clarence & Henry, 1990). The measure is a combination of true/false questions and free response items. Points are given for each correct response, and a “percentage correct” score is derived. In this study, the average score was 78% correct (range 57% to 98% correct).

Asthma Self-Efficacy
Self-efficacy was measured by using the children's Asthma Self-Efficacy Scale (Schlosser & Havermans, 1992). This self-report measure assesses the child’s perceptions of his/her ability to manage situations related to asthma. Children rate on a 5-point Likert scale how sure they are that they can negotiate asthma management tasks. Higher scores reflect greater perceived self-efficacy. A summary score is calculated by taking a mean of all items. This summary score has good internal consistency (α = .87) and has demonstrated relationships with other validated measures of child personality, coping, and asthma knowledge (Schlosser & Havermans, 1992). For the current sample, the average score was 3.9 (SD = .69).

Asthma Functional Morbidity
Parents completed the Asthma Functional Severity Scale (AFSS), which assesses the degree of functional impairment that asthma imposes on children’s daily functioning (Rosier et al., 1994). The scale examines four components of children's asthma morbidity, including frequency of episodes, frequency of symptoms between episodes, intensity of impairment during an episode, and intensity of impairment during the intervals between episodes. The functional morbidity index score is calculated by computing a mean across all completed items. Higher scores indicate greater levels of impairment. The AFSS was completed at the baseline session. Additionally, phone follow-ups were conducted every 3 months, for a total of four phone follow-ups over a 1-year period. At each phone follow-up, questions assessed morbidity in the previous 3 months. In such a way, a prospective morbidity score could be calculated over the course of a 1-year time span by taking the average score over all follow-ups. Response rates ranged from 52% to 65% across follow-up time points. Missing data on follow-ups were addressed by mean substitution of existing follow-up data. Follow-ups were completed with 86 families.

Results

Preliminary Analyses
Appropriate data transformations were applied to variables unlikely to conform to assumptions of normality and homogeneity of variance. Specifically, probit transformations, which normalize distributions of proportional variables (Cohen & Cohen, 1983), were applied to mean daily adherence and parent asthma knowledge scores, both of which were proportional data. Raw scores were retained for sample description.

Psychometric Properties and Validity of the FAMSS
Three sets of analyses were conducted to investigate the psychometric properties and validity of the FAMSS. First, relationships between subscales and demographic correlates of the FAMSS were examined. Secondly, analyses to assess the measure’s convergent validity were conducted through examining relationship between FAMSS subscales, self-report measures, and the index of daily medication usage as measured by the MDILog. Finally, a series of regression models evaluated the predictive validity of the FAMSS compared with other measures of asthma management in concurrent asthma morbidity.

Pearson product–moment correlations were used to assess the degree of association between various FAMSS subscales. These results, reported in Table II indicate many significant associations amongst subscales, with rs ranging from .12 to .73. Reliability analysis of the FAMSS summary score, comprised of the eight subscales, indicated good internal consistency (Cronbach’s α = .84).

The FAMSS summary score, as a global index of asthma management, was unrelated to age (r = 0.01, ns), child gender (r = .71, ns), child race, [F(3, 111) = 0.57, ns], or minority status [F(1, 111) = 0.08, ns]. The FAMSS
summary score was related to SES \((r = 0.31, p < .001)\), indicating poorer overall management in families with lower SES. The FAMSS summary score was not related to asthma severity, \([F(3, 111) = 2.19, \text{ns}]\). The FAMSS summary score was negatively related to the baseline functional morbidity index, \(r = -0.32, p < .001\). It was also negatively associated with the prospective functional morbidity score, reflecting morbidity data over the course of the year following initial data collection, \(r = -0.27, p < .05\).

### Convergent Validity

A series of analyses investigated the associations between FAMSS subscales, the FAMSS summary score, and other indices of asthma management (Table III). Parental performance on a standard measure of asthma knowledge (Fitzclarence & Henry, 1990) was positively correlated with FAMSS subscales of asthma knowledge, family response to symptoms, collaboration with physician, and the overall summary score. Child self-report of asthma self-efficacy was positively correlated with asthma knowledge, family response to symptoms, child response to symptoms, collaboration with physician, and the overall summary score. MDILog medication adherence was related to FAMSS subscales of medication adherence, physician collaboration, balanced integration of asthma into family life, and the overall summary score.

### Correlates of Asthma Morbidity: FAMSS Versus Self-Report Versus Electronic Monitoring

A series of hierarchical regression analyses investigated the incremental contribution of the different indices of asthma management (FAMSS summary score, self-report measures, and MDILog adherence assessment) in predicting baseline-asthma morbidity above and beyond baseline demographic variables of asthma severity, child race, and SES.

The first model investigated the independent contribution of the FAMSS summary score in explaining baseline morbidity when demographic variables had been taken into account. To control for the influence of asthma severity, child race/ethnicity, and SES, these variables were entered into a regression equation first and accounted for approximately 29% of the variance in baseline asthma morbidity scores (Table IV). The FAMSS summary score was entered on a second step, and accounted for approximately 18% more variance in asthma morbidity.

### Table II. Intercorrelations among Family Asthma Management System Scale (FAMSS) Subscales

<table>
<thead>
<tr>
<th>Asthma knowledge</th>
<th>Symptom assessment</th>
<th>Family response to symptoms</th>
<th>Child response to symptoms</th>
<th>Environmental control</th>
<th>Medication adherence</th>
<th>Collaboration with health care provider</th>
<th>Balanced integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma knowledge</td>
<td>.52**</td>
<td>.48**</td>
<td>.42**</td>
<td>.20*</td>
<td>.47**</td>
<td>.52**</td>
<td>.36**</td>
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<tr>
<td>Symptom assessment</td>
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<td>.26**</td>
<td>.26**</td>
<td>.30**</td>
<td>.45**</td>
<td>.45**</td>
<td>.23*</td>
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<tr>
<td>Family response to symptoms</td>
<td>.62**</td>
<td>.17**</td>
<td>.43**</td>
<td>.73**</td>
<td>.40**</td>
<td></td>
<td></td>
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<tr>
<td>Child response to symptoms</td>
<td></td>
<td>.12</td>
<td>.38*</td>
<td>.47**</td>
<td>.31**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental control</td>
<td></td>
<td></td>
<td>.20*</td>
<td>.32**</td>
<td>.49**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medication adherence</td>
<td></td>
<td></td>
<td>.53**</td>
<td>.55**</td>
<td>.49**</td>
<td></td>
<td></td>
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<tr>
<td>Collaboration with health care provider</td>
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</table>

*p < .05. **p < .01. ***p < .10.

### Table III. Relationships Between Family Asthma Management System Scale (FAMSS) Subscales, Self-Report Measures, MDILog Data and Asthma Morbidity

<table>
<thead>
<tr>
<th>Parent asthma knowledge</th>
<th>Child self-efficacy</th>
<th>MDILog medication adherence</th>
<th>Baseline asthma morbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma knowledge</td>
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<td>.35**</td>
<td>.17</td>
</tr>
<tr>
<td>Symptom assessment</td>
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<td>.12</td>
<td>-.05</td>
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<tr>
<td>Family response to symptoms</td>
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<td>.35**</td>
<td>.25*</td>
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<tr>
<td>Child response to symptoms</td>
<td>.28*</td>
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<td>.04</td>
</tr>
<tr>
<td>Environmental control</td>
<td>.19</td>
<td>.18</td>
<td>.06</td>
</tr>
<tr>
<td>Medication adherence</td>
<td>.13</td>
<td>.18</td>
<td>.30*</td>
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<tr>
<td>Collaboration with health care provider</td>
<td>.28*</td>
<td>.30*</td>
<td>.27*</td>
</tr>
<tr>
<td>Balanced integration</td>
<td>.13</td>
<td>.10</td>
<td>.41**</td>
</tr>
<tr>
<td>FAMSS summary score</td>
<td>.36**</td>
<td>.36**</td>
<td>.29*</td>
</tr>
</tbody>
</table>

*p < .05. **p < .01.
A second regression model provided a more stringent test of the FAMSS in explaining asthma morbidity by including self-reports (i.e., parent asthma knowledge and child asthma self-efficacy), and an objective assessment of medication adherence (i.e., MDILog adherence index), as predictors, and examining whether the FAMSS explained additional variance in morbidity beyond these measures. The demographic variables were again entered first and explained approximately 29% of the variance in asthma morbidity. The second step of the regression included the self-report and MDILog adherence index and accounted for an additional 11% of variance in asthma morbidity. The FAMSS was entered on the third step and accounted for an additional 11% of variance in asthma morbidity scores, for a cumulative $R^2$ of 51%.

**Discussion**

Poor adherence to treatment recommendations is a widespread issue across pediatric chronic illnesses (Bauman, 2000). Treatment approaches in pediatric asthma increasingly have emphasized the collaborative contributions of the child, family, and HCP in disease management. This has resulted in relatively high expectations for patients and families across a variety of disease management behaviors. As a result, appropriate evaluation of the multifaceted nature of asthma management has also become increasingly complex. Commonly used methods, such as self-report measures, are subject to bias. Electronic monitoring methods are more objective, yet expensive, and only capture discrete behaviors, such as the pattern of medication use over a given period.

Our research group has developed and refined a semistructured clinical interview to assess the multiple elements of pediatric asthma management. Information is integrated from the individual, family, and system levels to make an assessment of the efficacy of disease management behavior across multiple domains. Results from our ongoing work indicate that the FAMSS can be conducted and reliably coded by a range of clinical and research staff, including mental health professionals, nurses, and trained research assistants.

Findings from this study indicate that the summary score of the FAMSS has good internal consistency, and that the measure is related to concurrent and prospective assessments of asthma morbidity. It is of interest that in this study, the FAMSS summary score, although unrelated to racial/ethnic minority status, was related to SES. These findings suggest that barriers to effective management may be more a function of economic challenges, such as limited financial resources resulting in restricted access to health care, medications, and adequate housing, rather than cultural factors. Additionally, such economic challenges may result in the diminished capacity to optimally manage asthma as a family. Interventions targeting low-income families may benefit from attempting to enhance family-based asthma management skills, in addition to addressing limited economic resources. Finally, research efforts often confound ethnic minority disparities with economic disparities, whereas our results emphasize the importance of considering these issues as distinct public health priorities. Our findings suggest that compromised family-based asthma management skills may be an important mechanism underlying the propensity for diminished asthma outcomes among children from low SES backgrounds, in particular.

<p>| Table IV. Hierarchical Multiple Regressions Predicting Baseline Asthma Morbidity From Asthma Management Indices ($N = 53$) |
|----------------------------------|------------------|------------------|------------------|</p>
<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$ change for step</th>
<th>Cumulative $R^2$</th>
<th>$F$ change for step</th>
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</thead>
<tbody>
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<td>Model 1</td>
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<tr>
<td>1</td>
<td>Socioeconomic status</td>
<td>0.29</td>
<td>0.29</td>
<td>6.56***</td>
</tr>
<tr>
<td></td>
<td>Race Asthma severity</td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>FAMSS score</td>
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<td>0.47</td>
<td>15.67***</td>
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<td>0.29</td>
<td>6.56***</td>
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<tr>
<td></td>
<td>Race Asthma severity</td>
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<td></td>
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</tr>
<tr>
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<td>Parent asthma knowledge</td>
<td>0.11</td>
<td>0.40</td>
<td>2.58*</td>
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<td></td>
<td>Child self-efficacy</td>
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<tr>
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<td>FAMSS score</td>
<td>0.11</td>
<td>0.51</td>
<td>9.93**</td>
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*p < .10. **p < .05. ***p < .001
and child response to symptoms were related to children’s self-reports of self-efficacy to manage asthma. Lastly, subscale scores of medication adherence, family response to symptoms, collaboration with physician, and balanced integration of asthma into family life were associated with an objective assessment of medication adherence. These findings suggest that multiple elements of asthma management can be captured and quantified by using a semistructured interview.

Regression models indicated that the FAMSS explained additional, significant variance in asthma morbidity scores even after relevant covariates, self-report assessments, and an objective index of medication use were taken into account. These results indicate that a clinical assessment method, when systematically implemented, may yield more information in predicting asthma outcomes than either standard self-report measures or results of objective monitoring. Objective monitoring of adherence is a particularly costly and labor-intensive strategy for examining asthma management (Riekert & Rand, 2002), and the FAMSS may offer an informative and cost-effective alternative or complement to objective monitoring.

Some limitations of this study should be noted. The sample size, particularly of the subset of families who participated in the MDIlog assessment, was small. Given the limited power of the study, researchers chose to interpret correlations at the \( p < .05 \) level; however this may have increased the likelihood of Type I error, given the number of analyses conducted. Although the sample contained a proportion of children who were racial/ethnic minorities (28%), few Hispanic families participated, a demographic group with considerable asthma morbidity (Mannino et al., 2002). Future research will assess the Spanish translation of the instrument and its utility in characterizing disease management in this group. Additionally, we relied on parental report of child symptoms and activity limitation as our index of asthma morbidity. One could argue that parental reports of asthma morbidity are subject to bias and should be augmented by chart review or claim data analysis. One recent study, however, demonstrated that pediatric asthma status was well depicted by parent report of symptoms and functional status, and these measures performed as well or better than symptom diaries or objective pulmonary function testing when characterizing profiles of disease severity over time (Sharek et al., 2002). Although we evaluated the association of the FAMSS summary score with a prospective assessment of morbidity, our response rate was low, and similar findings across a larger sample of children would increase confidence in our results. Lastly, because of the smaller number of children who were involved in objective adherence monitoring, our regressions evaluating the relative strength of various assessment methods were based on concurrent morbidity.

### Applications for Research and Clinical Practice

To date, the FAMSS has been largely used in research protocols to provide a comprehensive assessment of family asthma management. Although it is more labor intensive to implement than standardized self-report instruments, it provides rich clinical data regarding family asthma management across multiple domains. Potential research applications include the identification of which specific elements of asthma management are most responsive to intervention and most predictive of improved asthma outcomes. For example, the FAMSS could be used in clinical trials of asthma-management programs to identify treatment goals at baseline and document treatment changes in key asthma-management variables over time.

The FAMSS has not been widely adopted for clinical use, although it has the potential to serve as a systematic method to collect information regarding family strengths and weaknesses in asthma management. In turn, it could be particularly useful in identifying barriers to effective management and tailoring treatment according to specific areas of need.

Pediatric asthma management within the family system remains a complex process that shifts over time in response to varying symptom presentation, child maturation, and advances in treatment approach. Employing methods that seek to capture this complexity may not only further our research agendas in pediatric chronic illness, but inform a comprehensive clinical approach to effective asthma management.

### Acknowledgments

This grant was supported by American Lung Association Grant CI-002-N, and the following grants from the NIH: R03 HD 37023, R01 HL45157, and M01 RR00069: General Clinical Research Centers Program.

Received April 30, 2004; revisions received August 13, 2004 and October 14, 2004; accepted October 14, 2004

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