Relationship of validated psychometric tools to subsequent medical utilization for asthma

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Background: Risk stratification is used to identify patients with asthma at increased risk of experiencing morbidity and resource utilization. Validated psychometric tools are infrequently studied sources of data for this purpose.
Purpose: To evaluate 4 types of validated psychometric tools as predictors for subsequent asthma utilization and determine their clinical usefulness.
Methods: Eleven hundred patients with active asthma from a Health Maintenance Organization completed surveys that included demographic information and validated psychometric tools measuring generic quality of life (physical and mental components), asthma-specific quality of life, asthma control, and asthma symptom severity. Survey records were linked to administrative data that captured emergency department and hospital care, short-acting β-agonist, and oral corticosteroid utilization for the year of and the year following the survey. Relationships of survey variables with subsequent utilization were assessed, adjusting for both baseline demographic and asthma utilization factors.
Results: Scores of each psychometric tool were significantly related to subsequent utilization in univariate analyses and after adjusting for baseline utilization and demographic risk factors. Patients with higher scale-defined morbidity were as much as 4 times more likely to have subsequent utilization (sensitivity as high as 58%; specificity as high as 78%). Addition of an asthma-specific tool to either demographic or utilization prediction models added sensitivity (as much as 15%) but did not substantially improve the prediction properties of models containing both demographic and utilization predictors.
Conclusion: Validated psychometric tools appear useful for asthma risk stratification in individuals and in populations in which both utilization and demographic predictors are not available. (J Allergy Clin Immunol 2005;115:564-70.)

Key words: *Quality of life, psychometric tools, asthma control, asthma severity, hospitalization, emergency care, antiasthmatic drugs*

Recent estimates suggest that 10% of Americans have asthma or have had asthma in their lifetime.[1] In addition to high prevalence, asthma is a cause of substantial morbidity, including hospitalizations, unscheduled physician and emergency department (ED) visits, and absences from school and work.[2] Moreover, chronic asthma is associated with very large direct and indirect costs.[3]

Asthma severity may vary in populations of patients, and risk stratification is thus used as part of asthma population management. The purpose of such risk stratification is to identify patients with asthma who are most likely to have morbidity and resource utilization and for whom targeted intervention would be expected to reduce these risks. Studies have shown that such interventions can reduce ED and hospital utilization in high-risk patients with asthma.[4-8]

Many studies have used clinical information[9-12] or computerized administrative data[13-16] to define risk factors for subsequent asthma utilization. Validated psychometric tools demonstrate reliability and validity across multiple domains and represent another source of potentially useful predictors of subsequent asthma resource utilization. Several types of psychometric tools have been studied in patients with asthma, including those measuring generic quality of life,[17,18] asthma-specific quality of life,[19-21] asthma control,[22-24] and asthma symptom severity.[25-27] One study demonstrated an independent association between generic quality of life and subsequent hospitalizations or ED visits in elderly patients with asthma,[28] but 2 other studies could not show that generic quality of life was independently associated with asthma hospital utilization.[25,29] Four studies have associated asthma-specific quality of life with asthma hospital utilization,[29-32] 2 of which were controlled for other risk factors.[29,32] Three studies have demonstrated an

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Abbreviations used
AOMS: Asthma Outcomes Monitoring System
AQLQ: Asthma Quality of Life Questionnaire
ATAQ: Asthma Therapy Assessment Questionnaire
ED: Emergency department
MCS: Mental Component Scale
NPV: Negative predictive value
OR: Odds ratio
PCS: Physical Component Scale
PPV: Positive predictive value
SF-12: Short Form 12

independent relationship between asthma control and subsequent utilization,[33-35] although only one of these used a control scale that had been formally validated.[33] Two studies have related asthma severity scales (which included symptom severity and other measures) to subsequent ED and hospital utilization,[25,36] although only one of these used a validated tool and adjusted for other predictors.[25] Although statistically significant relationships between these tools and subsequent asthma utilization were demonstrated in these studies, their clinical significance has not been established.

The purpose of this study was to evaluate 4 types of validated psychometric tools as predictors for several types of subsequent asthma utilization. In addition, we sought to identify the relationships of these tools to each other and the clinical usefulness of these tools in predicting subsequent ED, hospital, and rescue medication utilization for asthma.

METHODS

Patients

Surveys were sent by the Kaiser-Permanente Care Management Institute in August 2000 to a random sample of Kaiser-Permanente Medical Care Program adult members age 18 to 56 years from the Northern California (n = 3072) and Northwest (n = 543) regions who were diagnosed as having active asthma on the basis of the presence of 1 or more of the following administrative database criteria during 1999: (1) 4 or more asthma medication dispensings, (2) 1 or more ED visits or hospitalizations with a diagnosis of asthma, or (3) 4 or more asthma outpatient visits with 2 or more asthma medication dispensings. Completed surveys were returned between August and October 2000 from 2219 members (61%). Of these, 1998 (90%) answered yes to the question, ''Have you ever been told by a doctor that you have asthma?'' Of these, electronic utilization information was available for 1100, the participants of this study. Electronic utilization information was not available for subjects who did not meet these criteria for active asthma in 2000. The study was approved by the Northern California Region and the Northwest Region Kaiser-Permanente Institutional Review Boards.

Survey information

The survey included information regarding age, sex, race/ethnicity, educational attainment, household income, and smoking history. The validated tools included (1) the generic quality of life Short Form 12 (SF-12),[13] analyzed as the Mental Component Scale (MCS) and the Physical Component Scale (PCS); (2) the Mini Asthma Quality of Life Questionnaire (AQLQ) overall score[14]; (3) the Asthma Therapy Assessment Questionnaire (ATAQ),[17] an asthma control tool; and (4) the Asthma Outcomes Monitoring System (AOMS) Asthma Severity Staging Survey,[21] a symptom severity scale.

Utilization information

Survey records were matched by using a unique record number to year 2000 and 2001 administrative data. These electronic data included asthma hospitalizations, ED visits, canisters of short-acting β-agonists dispensed, and number of dispensings of oral corticosteroids. For the purpose of these analyses, the outcomes of hospitalizations and ED visits were combined into a single variable to increase power: presence of 1 or more asthma hospitalizations or ED visits (emergency hospital care) versus nonutilization. Use of short-acting β-agonists >14 canisters per year and any oral corticosteroid dispensings were evaluated, because these have been shown to be independent predictors of subsequent asthma hospital or ED utilization in this population,[37] and β-agonist overuse and oral steroid use are also risk factors for asthma mortality.[38,39] Outcome variables included the adverse asthma utilizations during year 2001 of emergency hospital care, dispensing of >14 β-agonist canisters, and oral corticosteroids. Year 2000 emergency hospital care, dispensing of >14 β-agonist canisters, and oral corticosteroid dispensings were used as baseline severity adjustors in the multivariable analyses.

Data analyses

Demographic and utilization characteristics of the population were evaluated by means of descriptive analyses. Hypothesis testing for univariate analyses of categorical variables was by means of χ^2 tests. Odds ratios (ORs) and 95% CIs were also calculated for analyses of 2-level variables. Two-level survey variables were defined on the basis of distribution, such that the lower quartile (25%) was in the high morbidity group for each scale. Because of limited scale scores, this was not possible for the ATAQ or AOMS. High morbidity groups for the ATAQ could be defined only as the lowest 33% (ATAQ $\geq$ 2) or the lowest 16% (ATAQ $\geq$ 3). High morbidity status for the AOMS included 38.6% of subjects who reported the highest score of 4.

Multivariable analyses were performed by using logistic regression methodology. Outcomes were year 2001 utilization variables (emergency hospital care, dispensing of >14 β-agonist canisters per year, and dispensing of oral corticosteroids). The main predictors were the survey scales described as continuous variables. Analyses were adjusted for the demographic factors and year 2000 utilization variables described. Because of potential colinearity, when more than 1 survey variable was included in a model, stepwise forward selection algorithms (with Wald χ^2 P for entrance $<$ .05) were used. The purpose of these analyses was to assess the independence of the survey variables in predicting utilization. The discrimination properties of the overall models (ability of the models to separate subjects in different outcomes states) were measured by the c statistic, which is the area under the receiver operating characteristic curve for each model. A value of 1.0 reflects perfect discrimination, whereas a value of 0.5 reflects no better discrimination than by chance alone.

To determine the clinical significance of the findings, predictive properties were evaluated. *Sensitivity* was defined as the proportion of subjects with subsequent utilization who were in the high morbidity group. *Specificity* was defined as the proportion of participants without subsequent utilization who were not in the high morbidity stratum. *Positive predictive value* (PPV) was defined as the proportion of patients in the high morbidity group with subsequent utilization. *Negative predictive value* (NPV) was defined as the