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The Asthma Control and Communication Instrument: A clinical tool developed for ethnically diverse populations

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Abstract

Background—Lower levels of quality asthma care among racially diverse populations might be due to inaccurate disease status assessments. The Asthma Control and Communication Instrument (ACCI) is a new tool that captures patient report of disease status during routine care.

Objective—We sought to test the ACCI's psychometric properties in a racially diverse population.

Methods—We performed a cross-sectional study. Subjects were recruited from specialist and generalist urban outpatient clinics. The ACCI and measures of asthma control, quality of life, lung function, and specialist rating of asthma status were collected. Four ACCI domains were separately validated: Acute Care, Bother, Control, and Direction. Principal component analysis, internal consistency, concurrent, discriminative, known-groups validity, and accuracy were evaluated.

Results—Two hundred seventy asthmatic patients (77% female subjects, 55% black) participated. ACCI Control domain internal consistency was 0.80. ACCI Bother, Control, and Direction domains showed strong concurrent validity with asthma control and quality-of-life

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measures (all P <.001). ACCI Acute Care and Direction domains showed strong concurrent validity with individual validation items (all P < .001). The ACCI Control domain discriminated clinically important levels of disease status measured by asthma control, quality of life (both P <. 001), and percent predicted peak expiratory flow rate (P = .005) and was associated with specialist rating of disease status (P < .001), confirming known-groups validity. The accuracy of the ACCI Control domain in classifying patients with uncontrolled asthma was very good (area under the curve, 0.851; 95% CI, 0.742–0.95870). Results were similar for both black and white subjects.

Conclusion—The ACCI is a promising clinical tool that measures asthma disease status during routine health care and is valid for use in both black and white populations.

Keywords

Asthma control; asthma treatment assignment; validation; racial disparities; quality of asthma care

Despite advances in our understanding of asthma pathophysiology and the availability of highly effective treatments, this chronic disease continues to disproportionately affect black subjects in the United States.[1–5] In fact, the gap in morbidity and mortality has widened between black and white subjects during the past 2 decades. In 2004, emergency department visits and hospitalizations were 457% and 340% higher among black subjects compared with those among white subjects, and in 2003, mortality was 267% higher.[6,7] Differences in assessment of asthma[8] and in the quality of asthma care received (eg, daily inhaled corticosteroid use, receipt of an asthma action plan, and referral to an asthma specialist) have been implicated as contributing factors to racial/ethnic disparities in the quality of asthma treatment independent of access to care, health insurance status, and socioeconomic status.[5,9–13]

Inaccurate assessment of disease status is most likely to occur in the context of poor clinician-patient communication about asthma during the clinical encounter. A number of studies have reported lower-quality communication between clinicians and minority patients.[14–17] Ineffective communication might arise because of low health literacy, lower educational status, lack of patient self-efficacy, and other cultural and language barriers.[5] For example, one study has suggested that the language used by African Americans with asthma to describe symptoms, such as breathlessness, might differ from that used by white patients.[18] Such differences could contribute to poor communication about asthma status between patients and providers and thus result in inaccurate estimations among black patients.

To improve office-based communication between patients and clinicians, we developed the Asthma Control and Communication Instrument (ACCI), which was designed to be culturally appropriate for use with diverse populations and to be of high clinical utility for clinicians. Although recommended by national asthma guidelines[19] to assess disease status, previously developed questionnaires[20–23] were not developed or validated for use with minority populations nor were they intended to redress disparities in asthma assessment and care.

In this study we provide evidence for construct validity of the ACCI. This type of validity tests theoretic relationships between a measure of interest (eg, ACCI) and 1 or more related measures (eg, quality of life [QOL] and spirometry). Because there is no gold standard for assessment of asthma disease status, we used several well-accepted related measures to provide evidence for construct validity[24,25] of the ACCI by testing for hypothesized cross-sectional associations in the context of a clinical encounter in urban clinical settings. Specifically, we evaluated whether the ACCI (1) effectively measures asthma disease status, (2) distinguishes clinically important differences of disease status, (3) accurately categorizes patients with uncontrolled asthma, and (4) performs adequately in both black and white patients.

METHODS

The ACCI: A brief description

The goals for development of the ACCI were to design a clinical tool that would (1) use language appropriate for diverse populations, (2) capture information about asthma that patients find important, (3) follow clinicians' rationale in assessing disease status and incorporating information they would find useful for grading morbidity, (4) be easy to implement in office settings, and (5) provide a quick and simple method to convert survey questions into meaningful severity/control classifications to guide treatment assignment.

The ACCI is a 12-item questionnaire (see Fig E1 in this article's Online Repository at www.jacionline.org) constructed for patient self-administration by persons 12 years and older before they are seen by their clinician (eg, in the waiting room of their physician's office). For the purposes of the validation study, physicians did not have the patient-completed ACCI to aid in their assessment of the patient; however, in clinical practice we anticipate that the patient will hand the completed survey to the physician at the beginning of the clinical encounter. The items included in the ACCI were selected through the qualitative analysis of focus groups of adult and teenage minority asthmatic patients recruited through local community centers in Baltimore, Maryland, and from a patient asthma education program at Howard University (Washington, DC) and clinicians (generalist [internists, family practitioners, and pediatricians] and specialist [pulmonologists, allergists, pediatricians, and geriatricians] physicians) from the Johns Hopkins Community Physicians (Baltimore, Md), Howard University, and Charter Health Plan (a health maintenance organization locate in Washington, DC) who treat asthmatic patients.[26,27] Based on feedback from these focus groups regarding item and response selection and wording, time frames, scoring system, and graphic formatting, the final ACCI questionnaire uses 4 domains of asthma disease activity assessment (Acute Care, also labeled as "Risk" [3 items], Bother [1 item], Control [5 items], and Direction of symptoms [1 item]), 1 domain for assessment of patient adherence to prescribed anti-inflammatory asthma medications (1 item), and 1 domain specifically designed to further enhance patient-physician communication (one open-ended question that states, "Please write down anything else you would like your doctor to know about your asthma.").

The time frame for the assessment of disease status with the ACCI Acute Care, Bother, and Direction domains is "since the last clinical visit" and for the ACCI Control domain is

"within the past week," except for nocturnal awakening, which was assessed over the "past two weeks." These time periods were recommended as clinically useful by physicians who participated in focus group sessions and endorsed by physicians who participated in cognitive interviews.[26,27] Based on feedback from the focus groups, the response choices to questions 1 to 11 are sequentially color coded from green (best) to yellow, orange, and red (worst) to easily alert the clinician to potential asthma problems. The ACCI is written at the fifth-grade reading level and takes approximately 5 to 7 minutes to complete.

The ACCI Control domain is the only multi-item component of the questionnaire that is scored by the clinician, according to patient responses. We provide 3 alternative scoring formats that can be used based on clinician preference. The first method, Categories, classifies patients into 4 categories ranging from mild-intermittent to severe-persistent, with mild-intermittent indicating better asthma disease status and severe-persistent indicating poorer asthma disease status. Consistent with asthma guidelines,[28] the Control category is assigned by the most severe response among the 5 ACCI control items. Patients with intermittent symptoms are considered "controlled," whereas those with persistent symptoms are considered "not controlled." The second method, Sum Score,[21] uses a summation of the 5 ACCI control items individually coded from 0 to 4 (except attack item, coded 0–3). The sum score ranges from 0 (better) to 19 (worse). The third method, Problem Index,[22] dichotomously rates each item as a control problem (yes or no), the values of which are then summed to provide a problem index ranging from 0 (no control problems) to 5 (5 control problems).

Previous versions of the ACCI were pilot tested and modified by using cognitive interviews of asthmatic patients and clinicians.[26,27] The ACCI showed excellent face and content validity and was rated by clinicians and patients as feasible and useful for periodic assessment of asthma disease status in an office-based setting.[27]

Study procedures

Between May 2005 and November 2006, subjects were recruited among adults (≥17 years) in waiting rooms of one specialty-referral center (n = 50 recruited specifically for this study) and 5 primary care, community-based outpatient clinics (n = 220) from urban areas of Baltimore, Maryland (as part of an ongoing clinical trial[29] to test the effect of the ACCI on quality of asthma care delivered in primary care settings). Subjects were eligible if they (1) had self-reported physician-diagnosed asthma, (2) were presenting for an already scheduled appointment, and (3) had evidence of active asthma (recent symptoms, reliever medication use ≥2 times per week, or both). Subjects provided informed consent and received a small financial incentive ($30.00) for participation. This study was approved by the Western Institutional Review Board (Olympia, Wash).

The 12-item ACCI was completed by the participants before seeing their treating clinician. After the clinical encounter, interviewer-administered questionnaires were used to collect additional information on demographics (including self-report of race/ethnicity), asthma treatment, and asthma health care use. To examine concurrent validity, we administered asthma control questionnaires (the Asthma Control Questionnaire [ACQ],[20] the Asthma Therapy and Assessment Questionnaire [ATAQ],[22] and the Asthma Control Test [ACT[21]]);

quality-of-life (QOL) questionnaires that assess asthma health (the Mini-Asthma Quality of Life Questionnaire [m-AQOL][30]), respiratory health (the St Georges Respiratory Questionnaire [SGRQ]),[31] and generic health (the 36-Item Short-form Health Survey [SF-36]);[32] spirometry; and specialist rating of the patient's asthma disease status.

All centers used the same model spirometer (KoKo Spirometer; Pulmonary Data Services, Lewisville, Colo) to assess pulmonary function. Percent predicted FEV_1 was calculated according to Hankinson's reference values adjusted for race/ethnicity.[33] Peak expiratory flow rate (PEFR) was also measured with the same spirometer. Standardized techniques were carried out according to American Thoracic Society recommendations.[34] Maneuvers were done without the administration of albuterol.

Specialists were asked to rate their patient's asthma disease status immediately after the encounter in 2 ways: (1) dichotomously (ie, controlled or not controlled) and (2) categorically (from mild-intermittent to severe-persistent). They were blinded to patients' ACCI responses and relied exclusively on information obtained from the clinical encounter to rate their patients.

Because this study did not include objective measures of adherence to controller medication, we do not report validation of the ACCI adherence item. The open-ended item (question 12) was not subject to validation because it captures a potentially wide range of issues important to the patient.

Analysis

Descriptive statistics were used to characterize the study population and survey responses. Principal component analysis (PCA) with varimax rotation was used to evaluate the ACCI item components.[35] The number of components was determined from eigenvalues of greater than 1 and their clinical interpretability. The Cronbach α statistic was used to measure the internal consistency reliability of components, when applicable.

Concurrent validity—To evaluate concurrent construct validity (ie, the presence of associations between variables that, based on prior knowledge, would be expected to associate well [convergent validity] and not to associate well [divergent validity]), we tested the associations between the ACCI Bother, Control, and Direction domains with (1) asthma control, (2) QOL, and (3) lung function by using Pearson correlation coefficients (appropriate for scaled data in studies with larger sample sizes).[20] We hypothesized that worse ACCI ratings of the Bother ("very bothered"), Control (higher sum-scores and problem index), and Direction ("worse") domains would correlate with worse rating of disease status assessed by using validation measures. We also hypothesized that ACCI Bother, Control, and Direction domains would correlate more strongly with asthma control and asthma-specific QOL measures than with generic QOL measures and, within QOL, more strongly with symptom and activity domains than with emotional and environmental domains. Furthermore, we expected lower correlations with unrelated measures of asthma disease status (eg, SF-36 Mental Component summary score). Additionally, we compared the ACCI Direction domain (worse) with the SF-36 item "health now compared to one year ago" (worse or much worse) by using the Pearson χ^2 test.

We tested the associations between ACCI Acute Care items (hospitalization, emergency department use, and oral steroid use) and patient self-report of "ever" having had a hospitalization, had an emergency department visit, and taken oral steroids, respectively, by using Pearson the χ^2 test.

Discriminative properties—To test for discriminative properties, we examined mean asthma control, QOL, and lung function values across ACCI category ratings (mild-intermittent to severe-persistent) by using ANOVA and test for linear trend. We also examined whether ACCI category ratings discriminated minimal clinically important differences (MCIDs), which are the smallest changes in an instruments' score that are perceived to be beneficial by patients or clinicians or one where a change in treatment would occur.[36] MCID values have been described for the ACQ (ie, 0.5),[37] the m-AQLQ (ie, 0.5),[38] the SGRQ (ie, 4.0),[39] the SF-36 (ie, 10–16.7, according to each of the 8 subscales),[40] FEV_1 (ie, 0.23 L), and PEFR (18.8 L/min).[41]

Known-groups validity—To test for validity by using the logic of known-groups validity,[21,42] specialist rating of asthma disease status mild-intermittent to severe-persistent and controlled versus not controlled were used. We hypothesized that groups classified as mild-intermittent or controlled by specialist rating would score lower (better) on ACCI Control sum scores and problem index than groups rated by specialists as severe-persistent or not controlled. We also calculated the percentage of agreement between ACCI categories controlled/not controlled versus specialist rating of controlled/not controlled.

Accuracy—To measure the accuracy of the ACCI Control domain in identifying patients who are not controlled, as determined by specialists, we used receiver operating characteristic (ROC) analyses[21,43,44] with the SPSS ROC curve option. Cutoff points were chosen by using the highest value of the following ratio: $Se/(1-Sp)$. Areas under the ROC curves of greater than 0.8 were considered "good."[45] Sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio, and negative likelihood ratio were also computed. To select cutoff points, we used the highest sensitivity/specificity ratio.

In addition, the κ statistic was used to account for chance agreement between the ACCI rating of control and specialist rating of control.

Validation across race/ethnicity—All described analyses were computed for the entire group and additionally stratified by self-report of race/ ethnicity, except for known-groups validity analysis because of small sample size (n = 50).

Statistical significance was accepted at a P value (2-tailed) of less than .05. Analyses were performed with SPSS 14.0 (SPSS, Inc, Chicago, Ill) and STATA 9.2 (StataCorp, College Station, Tex) software.

RESULTS

The majority of subjects were female (77%), more than half were black (55%), nearly half had a combined yearly household income of less than $30,000, and 81% were recruited from the primary care community-based outpatient clinics (Table I).

Seventy-one percent of our population was classified by the ACCI categories as having moderate or severe-persistent disease (see Table E1 in this article's Online Repository at www.jacionli-ne.org). The rate of missing values for each ACCI domain was less than 5%. Floor and ceiling effects of the ACCI sum scores were 1% and 0%, and those of the ACCI problem index were 5.2% and 29%.

PCA showed that 4 components explained 65% of the variance of the model. All 11 ACCI items (item 12 was not introduced into the model because of its qualitative nature) loaded significantly onto one of the 4 components, and there were no inconsistencies in loadings (see Table E2 in this article's Online Repository at www.jacionline.org).

Concurrent validity

ACCI Bother, Control, and Direction domains showed convergent and divergent construct validity with asthma control, QOL, and spirometric values (Table II). For the ACT, m-AQLQ, and SF-36, higher values represent better health status, whereas the reverse is true for the ACQ, ATAQ, SGRQ, and ACCI, explaining the negative and positive direction of the correlations between the ACCI and these validation measures, respectively. As expected, ACCI Bother, Control, and Direction domains showed higher correlations with overall asthma control and asthma and respiratory QOL values than with generic QOL values.

The ACCI Acute Care items "hospitalizations," "emergency department visits," and "use of oral steroids" were positively associated with patient self-reports of ever having been hospitalized, ever having an emergency department visit, or ever having used an oral steroid for asthma, respectively (all $P \leq .001$). A worse ACCI Direction rating ("worse since last visit") was more likely reported when SF-36 report ("health now compared to one year ago") was "worse" or "much worse" ($P < .001$).

Discriminative properties

As hypothesized, ANOVA showed that the ACCI category rating (mild-intermittent to severe-persistent) significantly discriminated levels of asthma control, QOL (except for the SF-36 mental component summary), PEFR absolute and percent predicted values, and FEV_1 absolute values (Table III). Although FEV_1 percent predicted values decreased as ACCI category ratings were worse (mild-intermittent to severe-persistent), these results were not statistically significant (P trend = .095). MCIDs of ACQ, m-AQLQ, and SGRQ values were evidenced between ACCI category ratings (Table III). For example, the differences of ACQ values between each of the ACCI categories were 0.6, 0.7, and 0.7, all greater than the recommended MCID value of 0.5. Although there are no recommended values of MCID for the summary scores of SF-36, there are MCIDs in asthma populations for each of its 8 subscales.[40] Analyses of the discriminative properties for each of the 8 subscales were performed, and all P values were less than .001, except for the SF-36 Role Emotional

subscale (P =.467). MCIDs between ACCI category groups were reached, as expected, for SF-36 Physical Functioning and Role Physical subscales, with values of 15 and 12.5, respectively.

Known-groups validity

The ACCI Control sum score and problem index significantly discriminated among groups known to differ in asthma control, as defined by specialist rating of control (Table IV). As hypothesized, mean ACCI Control sum score and control problem index values varied significantly across the groups of patients who differed in their level of asthma control (mild-intermittent to severe-persistent and controlled vs not controlled), as assessed by specialists (all P < .001).

The ACCI and specialist rating of patients as controlled agreed in the majority of cases (68%). Importantly, the ACCI only rated the patient as controlled when the specialist rated him or her as not controlled in 2% of the cases. However, agreement in excess of chance between the ACCI and specialist rating of a patient as controlled was low (κ = 0.16, P =. 045).

Accuracy of ACCI Control domain

The area under the ROC curve of the ACCI sum score and problem index showed that both scoring systems were very good at predicting specialist rating of asthma disease status as not controlled (ACCI Control sum score: area under the curve [AUC], 0.851 [95% CI, 0.742–0.958); ACCI Control problem index: AUC, 0.845 [95% CI, 0.732–0.959]). An ACCI Control sum score cutoff value of less than 9 and an ACCI Control problem index of less than 2 were chosen to identify individuals considered not controlled because these values showed an optimal sensitivity/ specificity ratio (ACCI sum score, 75%/83%; ACCI problem index, 81%/78%), positive/negative predictive value ratio (ACCI sum score, 89%/65%; ACCI problem index, 87%/70%), and positive/negative likelihood ratio (ACCI sum score, 4.5/0.30; ACCI problem index, 3.6/0.24).

ACCI validation across race

Mean values of ACCI Control sum score were higher (worse) among white subjects compared with black subjects (9.2 vs 7.9, P =.02). PCA results were essentially the same, except for the ACCI Bother domain, which loaded with items related to the Control domain rather than with the Direction domain among black subjects. However, and most importantly, concurrent and discriminant properties were comparable in both groups. As examples, for concurrent validity, correlations between the ACCI Control domain and the following measures (white vs black subjects) were as follows: ACQ (0.69 vs 0.70, both P <. 001), AQOL overall (−0.68 vs −0.59, both P <.001), SGRQ overall (0.63 vs 0.45, both P < . 001), SF-36 physical component summary (−0.42 vs 0.34, both P < .05), and FEV_1 percent predicted (−0.23 vs −0.11, P =.02 and .18, respectively). In addition, as examples of discriminant validity, mean values of asthma control measures, QOL, and spirometry across the ACCI Control categories mild-intermittent to severe-persistent are shown in Table E3 (available in this article's Online Repository at www.jacionline.org).

DISCUSSION

The ACCI is a new asthma instrument designed to follow clinicians' rationales in assessing asthma disease status to assign treatment, and it was specifically developed for use with diverse populations.[26] The present study shows that, in the context of a health care visit, the ACCI has strong construct validity in both black and white patients and thus effectively measures asthma disease status in both black and white patients.

Although other well-known measures of asthma disease status are currently available,[20–23] none of these commonly used measures were specifically developed or validated among black patients with asthma. The ACCI is also unique in its inclusion of 3 other dimensions of disease status commonly used by clinicians in asthma care in addition to asthma control.[46] PCA confirmed that the domains of Acute Care, Bother, and Direction (originally derived from qualitative research) reflect dimensions of asthma disease status that are distinctly different from asthma control and suggests that these domains should be assessed separately. Moreover, we have also recently shown in a national sample of pediatricians, generalists, and specialists that the 4 ACCI domains significantly and independently contribute to physician decisions regarding stepping up and down medication regimens.[47] An additional unique feature of the ACCI is its inclusion of both long and short recall time frames of asthma status, which clinicians routinely use[26] and are easy for patients to recall.[27] Stoloff and Boushey[48] recently emphasized the importance of incorporating both long- and short-term assessments of asthma disease status justified by the fact that short-term assessment of symptom burden underestimates the long-term functional burden of asthma.[49] Finally, the ACCI is culturally sensitive by incorporating language that is commonly used by black and Latino patients when describing disease status. For example, we use the words "pump" and "machine" for inhaled meter-dosed inhaler and nebulizer, respectively, in the reliever use question and provide specific definitions of "asthma attack" as a result of our focus groups and cognitive interviews with minority patients. By using this approach, we have aimed to have survey questions that would be readily understood by minority patients.

The construct validity of the ACCI is supported by the fact that the concurrent associations between ACCI Bother, Control, and Direction domains and measures of asthma control, QOL, and lung function were present and followed expected hierarchic patterns. The highest correlations between ACCI Bother, Control, and Direction domains were found for the ACT and ACQ, 2 specific measures of asthma control, and the lowest correlation was found for the SF-36 Mental summary component and absolute and percent predicted FEV_1 values. ACCI Control values also more highly correlated with Symptom and Activity m-AQLQ subscales than with m-AQLQ Environment and Emotions sub-scales, which is consistent with the notion that the former sub-scales more closely address clinical symptomatic complaints, whereas the Environment and Emotions subscales are centered on the perceived burden of the disease.

Additionally, the construct validity of the ACCI is evidenced by the discriminative properties of the ACCI category scoring system. The value of assessing discriminative properties is that it provides information on how well an instrument distinguishes different levels of impaired

health between patients.[50] For example, a discriminative instrument can provide information about patients who are healthy and about which patients have various degrees of impairment. Values of asthma control, QOL, and percent predicted PEFR showed clear gradients across the ACCI category ratings of mild-intermittent to severe-persistent and, more importantly, reached the proposed MCIDs for the ACQ (0.5), m-AQLQ (0.5), and SGRQ (4.0).

Further confirmation of ACCI discriminative properties resulted from categorizing patients into groups known to differ in asthma disease status according to specialist rating (mild-intermittent to severe-persistent and controlled/not controlled). We observed a strong gradient of ACCI Control sum scale/problem index values across specialists' ratings of disease status, therefore discriminating very well between groups of patients who differ in asthma disease status according to an accepted clinical measure according to the logic of known-groups validity.[42] We also assessed discriminative properties using ROC curve analysis. This method provides a standard way of reporting a scale's performance as a measure of accuracy and permits the comparison of scales with each other. Based on our results, we found that the ACCI Control sum scale and problem index performed very well against specialists' ratings of disease status. Similar analyses have been reported for the ACT[21]; however, the ACCI Control domain was slightly more accurate in predicting the specialist rating as not controlled than the ACT (ACCI AUC sum scale and problem index = 0.851/0.845 vs ACT AUC sum scale and sum of counts = 0.774/0.766). Thus the ACCI appears to accurately measure asthma control at least as well as another well-recognized survey tool. Finally, when analyzing the percentage of agreement between the ACCI and specialist rating, the ACCI identified nearly all patients who would qualify, by guidelines, for additional evaluation and treatment. It is notable that the κ values, although statistically significant, are quite low. This finding is not surprising because studies have previously shown that clinicians making a global assessment of asthma severity tend to strongly and systematically underestimate the level relative to what patient's report.[51,52]

One strength of the current study is the inclusion of a diverse population of patients (mostly black and white patients) in the context of a health care visit with both generalist and specialist clinicians in outpatient medical clinics. Generalist clinicians are responsible for the great majority of asthma care in the United States, and the ACCI performed well among patients who were visiting a generalist. Furthermore, unlike many asthma clinical trials, our study did not exclude participants if they self-reported other comorbidities (including chronic obstructive pulmonary disease), were currently smoking, or were obese. Thus our results are more likely generalizable to "real-world" patients being treated in outpatient urban clinics.

To promote standardization of treatment, national and international asthma guidelines have recommended that quality asthma care requires assigning and modifying treatments according to periodic assessments of asthma disease status, currently known as asthma severity and asthma control.[19,28,53] Given that underassessment might be a contributing factor to the lower-quality asthma care of minority patients, one approach to redress that is to facilitate broader, more in-depth assessments of asthma status: we believe the ACCI affords such an opportunity. Instruments such as the ACCI, ACT, and ACQ offer an opportunity for clinicians to standardize and improve their assessment and care of asthmatic

patients. Ultimately, such instruments should aid in reducing racial disparities in asthma care by standardizing asthma assessment. Future research will be needed to demonstrate whether use of these instruments improves asthma care. However, standardized assessment tools have been successfully implemented in other settings (eg, APGAR and Acute Physiology and Chronic Health Evaluation scores), and therefore it is reasonable to expect that with proper integration into clinical practice, standardized assessments would improve asthma care. We are currently in the process of finishing a clinical trial testing the ACCI in urban, diverse, primary care settings in improving the quality of care among patients with asthma by improving patient-clinician communication about asthma health status.[29]

There are several limitations to this study. First, the criteria used are not conclusively recognized as gold standards for the measurement of asthma disease status. However, a gold standard does not currently exist, and the measures selected for this study have been widely used in previous validation studies.[20–23]

Second, most of our data collection was based on self-report, and results are subject to reporting bias. However, self-reported indicators of asthma disease status have been shown to be predictive of other measures of asthma burden, such as asthma health care use.[54]

Third, our validation process was cross-sectional, and therefore we cannot yet report evaluative properties for the ACCI; a longitudinal study is currently underway.

Fourth, few of our patients had well-controlled disease, which might limit the generalizability of our findings to a population of subjects with very mild asthma.

Finally, although the ACCI was developed among ethnically diverse populations (white, black, and Hispanic), our study participants were mostly black (55%) or white (40%), were able to read and speak English, and were recruited from urban clinical settings, and therefore our results might not be generalizable to populations of other races and ethnicities, those who cannot read or speak English, and those who receive care in suburban or rural settings.

In summary, the results of this study support the reliability and validity of the ACCI as a measure of asthma disease status. These findings suggest that the ACCI can be considered suitable for use in clinical and epidemiologic research studies among diverse populations that also include black participants. Use of the ACCI in clinical care has the potential to increase the quality of asthma care, especially for black subjects, by offering a systematic approach to periodic disease status assessment during the clinical encounter and thereby reduce asthma disparities. Additional research will be needed to determine the effect of use of the ACCI on the quality of asthma care in minority populations in urban clinical settings.[13]

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations used

CCI	Asthma Control and Communication Instrument
ACQ	Asthma Control Questionnaire
ACT	Asthma Control Test
ATAQ	Asthma Therapy and Assessment Questionnaire
AUC	Area under the curve
m-AQLQ	Mini-Asthma Quality of Life Questionnaire
MCID	Minimal clinically important difference
PCA	Principal component analysis
PEFR	Peak expiratory flow rate
QOL	Quality of life
ROC	Receiver operating characteristic
SF-36	36-Item Short-form Health Survey
SGRQ	St Georges Respiratory Questionnaire

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Clinical implications

The results of this study support the reliability and validity of the ACCI as a measure of asthma disease status, particularly for minority patients with asthma.

TABLE I

Patient characteristics (n = 270)

Age (y), mean (SD), range	48 (14), 17–88
Female sex	77%
Race	
Black	55%
White	40%
Other	5%
Education	
Less than 12th grade	26%
High school graduate	57%
College/graduate/postgraduate	17%
Household annual income	
<$30,000	44%
≥$30,000	44%
Refused/don't know	12%
Health care insurance	
Private	54%
Public	42%
Other	4%
Smoking status: current smoker	51%
Comorbidities	
COPD	30%
Allergic rhinitis	42%
Body mass index (kg/m^2), mean (SD), range	33 (9.1) 17–74

COPD, Chronic obstructive pulmonary disease.

TABLE II

ACCI concurrent validity: ACCI Bother, Control, and Direction domains by asthma control, QOL, and spirometry using the Pearson correlation coefficient

	ACCI Bother	*P* value	ACCI Control	*P* value	ACCI Direction	*P* value
Asthma control measures						
ACT	−0.447	<.001	−0.763	<.001	−0.290	<.001
ACQ	0.446	<.001	0.744	<.001	0.357	<.001
ATAQ	0.111	.069	0.346	<.001	0.084	.167
QOL measures						
m-AQLQ domains						
Overall	−0.387	<.001	−0.646	<.001	−0.211	.001
Symptoms	−0.405	<.001	−0.689	<.001	−0.280	<.001
Activities	−0.246	<.001	−0.565	<.001	−0.182	.003
Environment	−0.302	<.001	−0.431	<.001	−0.097	.111
Emotions	−0.300	<.001	−0.389	<.001	−0.097	.113
SGRQ domains						
Overall	0.337	<.001	0.533	<.001	0.266	<.001
Symptom	0.333	<.001	0.448	<.001	0.185	.006
Activity	0.226	.001	0.417	<.001	0.142	.035
Impact	0.343	<.001	0.417	<.001	0.319	<.001
SF-36 domains						
Physical CS	−0.295	.001	−0.467	<.001	−0.132	.130
Mental CS	−0.162	.063	−0.117	.185	−0.095	.277
Spirometric values						
FEV_1 (L)	−0.059	.341	−0.023	.706	0.098	.110
FEV_1 % predicted	−0.068	.277	−0.176	.005	0.035	.569
PEFR (L/s)	−0.060	.334	−0.037	.553	0.098	.112
PEFR % predicted	−0.033	.603	−0.240	<.001	−0.112	.075

CS, Component summary.

TABLE III

ACCI discriminant properties: Mean (95% CI) asthma control, QOL, and spirometric values across ACCI control categories by using ANOVA

	ACCI Mild-intermittent	ACCI Mild-persistent	ACCI Moderate-persistent	ACCI Severe-persistent	*P* trend
Asthma control measures					
ACT	20 (19–22)	18 (18–19)	15 (14–16)	12 (11–13)	<.001
ACQ	1.4 (1.1–1.7)	2 (1.9–2.1)	2.7 (2.6–2.9)	3.4 (3.1–3.6)	<.001
ATAQ	2.3 (1.9–2.6)	2.4 (2.1–2.6)	2.7 (2.5–2.8)	2.8 (2.6–2.9)	.032
QOL measures					
m-AQLQ domains					
Overall	6.0 (5.5–6.4)	5.2 (5.0–5.5)	4.5 (4.3–4.7)	3.6 (3.3–3.9)	<.001
Symptom	5.9 (5.4–6.4)	5.2 (5.0–5.4)	4.3 (4.1–4.5)	3.4 (3.1–3.7)	<.001
Activity	6.6 (6.1–7.0)	5.6 (5.3–5.9)	5.0 (4.8–5.3)	4.0 (3.6–4.4)	<.001
Environmental	5.2 (4.3–6.1)	4.8 (4.4–5.1)	3.9 (3.7–4.2)	3.2 (2.8–3.6)	<.001
Emotional	6.0 (5.2–6.9)	5.1 (4.9–5.6)	4.6 (4.3–5.0)	3.9 (3.5–4.4)	<.001
SGRQ domains					
Overall	23 (15–31)	39 (34–43)	44 (40–47)	55 (50–60)	<.001
Symptom	46 (32–59)	55 (51–60)	59 (56–63)	70 (65–74)	<.001
Activity	26 (15–42)	51 (44–58)	57 (52–62)	68 (62–74)	<.001
Impact	12 (4–21)	27 (23–32)	31 (27–35)	42 (37–48)	<.001
SF-36 domains					
Physical CS	50 (43–56)	43 (39–47)	39 (35–42)	31 (27–34)	<.001
Mental CS	48 (24–73)	45 (41–49)	44 (40–47)	45 (40–49)	.706
Spirometric values					
FEV_1 (L)	2.5 (1.9–3.0)	2.2 (2.0–2.4)	2.1 (1.9–2.2)	2.0 (1.8–2.2)	.028
FEV_1 % predicted	80 (71–90)	75 (70–80)	74 (71–78)	71 (65–76)	.095
PEFR (L/s)	6.2 (4.9–7.5)	5.1 (4.6–5.5)	4.7 (4.4–5.0)	4.4 (4.0–5.0)	.001
PEFR % predicted	88 (74–102)	73 (67–79)	72 (68–76)	66 (59–72)	.005

CS, Component summary.

TABLE IV

ACCI known-groups validity: ACCI Control domain mean (95% CI) sum scores and problem indeχ across specialist rating of asthma disease status (n = 50)

	Specialist rating of asthma disease status				
	Mild-intermittent	**Mild-persistent**	**Moderate-persistent**	**Severe-persistent**	***P* trend**
ACCI Control sum score	8.1 (6.8–9.4)	12.9 (9.5–16.2)	14.1 (12.1–16.1)	17.4 (14.8–19.9)	<.001
ACCI Control problem index	1.2 (0.70–1.7)	3.3 (1.9–4.7)	3.6 (2.9–4.3)	4.2 (3.2–5.2)	<.001
	Specialist rating of asthma disease status				
	Controlled		**Not controlled**		***P* trend**
ACCI Control sum score	9.2 (7.6–10.9)		15.4 (13.9–16.9)		<.001
ACCI Control problem index	1.7 (0.98–2.3)		3.8 (3.3–4.4)		<.001