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Assessing the Validity of the RAND Negative Impact of Asthma on Quality of Life Short-Forms

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Abstract

Background—In response to recommendations from the 2010 NIH Asthma Outcomes Workshop, we developed a system for measuring the negative impact of asthma on Quality of Life (QoL), referred to as the RAND Negative Impact of Asthma on Quality of Life (RAND-IAQL) item bank. The bank contains 65 items that focus on the patient’s perception of the *impact* or *bother* of asthma on his or her life.

Objective—Evidence for the validity of two short-forms, The RAND-IAQL-4 and 12, from the bank is presented.

Methods—Using a sample of 2032 adults with asthma, we validated our short-forms against the Marks Asthma Quality of Life Questionnaire (M-AQLQ); The Asthma Control Test; and generic measures of QoL developed by PROMIS®. Discriminant validity was examined by comparing scores of respondents who differed according to multiple health indicators.

Results—Our sample ranged in age from 18–99 (mean of 43), 14% of whom were Hispanic, 11% Asian, 19% African American and 56% non-Hispanic White. Men had significantly worse impact of asthma on QoL than women. Impact of asthma on QoL was greatest in African Americans and Hispanics compared to non-Hispanic Whites. Our measures correlated highly with Marks AQLQ and more strongly with the PROMIS® global physical than mental scale. They differentiated between adults with asthma according to their perceived severity, level of control, presence or absence of exacerbations and physical comorbidity.

Conclusion—The RAND-IAQL item bank, measuring the impact of asthma on QoL, will complement other patient-reported outcomes such as measures of asthma symptoms, functioning and control.

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Keywords

Validity; Asthma; Quality of Life; Short-Forms

Introduction

The 2010 NIH asthma outcomes workshop recommended that a new generation of quality of life (QoL) instruments were needed that focused specifically on the patient's perception of the impact of asthma on QoL, separate from measures of asthma symptom, functioning or control.¹ This recommendation is consistent with the recent emphasis in patient centered outcomes research on patient perceptions and outcomes that people care about including their health-related QoL.² In this era of rising health care costs, there is a need for standard outcomes that allow for comparisons across clinical trials and other research studies to inform what works in patient care from the patient's point of view and allow for patient informed choices in health care. While historically clinicians have been concerned with physiological and clinical symptom control measures, these outcomes have not been shown to be strongly related to how patients with asthma feel about the burden associated with their asthma on aspects of their everyday life.^{3,4} QoL concerns may be one reason why patients choose one type of treatment over another. In addition, administration of the treatment may affect QoL independent of its effect on disease control. Asthma-specific QoL measures have the potential to offer detailed information on the impact of asthma that is complementary to information obtained from measures of asthma control and lung functioning and that is more sensitive than generic measures of QoL to smaller differences and smaller change over time.⁵ While there are a number of established measures that have been used to measure QoL in asthma, most contain items that reflect symptoms and level of functioning as well as perceived impact.⁶⁻¹⁷ Thus, to disentangle these concepts, the QoL subcommittee recommended development of new measures focused primarily on perceived impact of asthma on QoL.

In response to this recommendation, we developed the RAND Negative Impact of Asthma on Quality of Life (RAND-IAQL) item bank of 65 asthma-specific QoL items.¹⁸⁻¹⁹ New items developed from patient focus groups, existing QoL items from a literature review of outcome measures for asthma, and recommendations from experts on asthma were assessed with state-of-the art psychometric methods including item response theory. Analyses supported the unidimensionality of the 65 items, suggesting that all items in the bank measure the same underlying construct. An item bank containing a large set of items, such as the RAND-IAQL bank has many advantages over traditional scales. For example, not all the items in the bank need to be administered in order to produce a reliable score. Items can be administered adaptively (i.e., with computer adaptive testing; CAT), or reliable subsets of items can be drawn from the bank manually to produce traditional, brief fixed-length instruments (i.e., short forms) that retain the psychometric advantages of the larger item bank.

Two short forms were developed from the RAND-IAQL 65-item bank.¹⁹ The first is based on the determination that the impact of asthma on global aspects of QoL could be reliably

assessed with as few as four carefully selected items (i.e., the RAND-IAQL-4; marginal reliability = .86). For the second, we broadened the content coverage and increased precision by adding 8 additional items (RAND-IAQL-12; marginal reliability = .93). These short forms are highly intercorrelated ($r = .96$) and correlate highly with the RAND-IAQL-BANK scores ($r = .93$ and $.97$, respectively), indicating that both short forms adequately represent the underlying latent dimension of asthma.

This paper reports information on the construct and discriminant validity of the short-form instruments and provides descriptive information about the ways in which QoL scores vary by demographic and health characteristics of the sample.

Methods

Subjects

Data come from a national sample registry of English-speaking adults (ages 18+) with asthma who were recruited by Harris Interactive (www.harrisinteractive.com), a global interactive media and services company that administered the items via internet assessment. Recent research suggests that internet-based sampling is feasible and that samples gathered in this manner and their findings do not differ significantly from samples and findings drawn with traditional methods.²⁰ Eligible subjects included those in the registry who self-reported asthma and who confirmed that they had been told by a doctor or other health professional that they had asthma and reported that they still have asthma. To assure variability across a range of asthma severity, we required that 90% of the sample had experienced an episode of asthma or an attack in the prior 12 months.²¹ African Americans, Asians and Hispanics were oversampled in order to obtain at least 200 interviews from each for psychometric analyses reported earlier.¹⁹ Similarly, targets were set within each of four age groups (18–34, 35–49, 50–64 and 65+) to enable sufficient power for sub-group analyses. The sample was also recruited to reflect the gender distribution of asthma in the general U.S. adult population (40% men and 60% women).²² All participants received points through Harris's online loyalty program which could be redeemed for gifts such as an Amazon gift card.

The study was approved by RAND's Institutional Review Board.

Measures

RAND Negative Impact of Asthma on Quality of Life short forms (RAND-IAQL-4, RAND-IAQL-12)—We developed two short form representations of the item bank consisting of 4 and 12 items judged as psychometrically strong and widely relevant across the latent QoL continuum.¹⁹ Content of the items are provided in Table 1. The measures' standardized scores are derived from an IRT model, which has been translated along a T-score metric with a mean of 50 for the field test population and standard deviation of 10.¹ Higher scores indicate more perceived negative impact of asthma on one's QoL. For example, a score of 60 is one standard deviation above the mean and suggests more impact of asthma on QoL. There was very little missing data for the QoL items in our sample. Only 34 of 2032 (1.7%) were missing one or more of the items in the IAQL-4 and therefore received a missing scale score. Only five (<1%) were missing more than 6 in the IAQL-12.

As per the Patient-Reported Outcomes Measurement Information System (PROMIS®) scoring rules, subjects who had 6 or fewer missing in the IAQL-12 received the mean score of the non-missing items (N=86 or 4%). Scoring algorithms are provided on the RAND website (http://www.rand.org/health/surveys_tools/iaql.html).

Marks Asthma Quality of Life Questionnaire—We validated our short-form measures against the Marks Asthma Quality of Life Questionnaire (AQLQ-M) which includes 20 questions yielding a total QoL score and 4 subscales: breathlessness, concern, mood, and social.¹⁵ This measure has been shown to have good cross-sectional construct validity and reproducibility^{16,27} and to predict asthma severity, work days missed and to be responsive to changes in pulmonary function.⁸

Asthma control—The Asthma Control Test (ACT)²⁸ was used to measure asthma control, a multidimensional construct that encompasses symptoms as well as use of rescue medications, and the effect of asthma on daily functioning. The ACT consists of 5 items, and has strong psychometric properties, including good internal consistency, test-retest reliability, validity, and responsiveness.^{17,29,30} Scores on this 5-item measure range from 5 to 25 with cutoffs of 5–15 (poorly controlled), 16–19 (somewhat controlled), and 20–25 (well controlled).

Generic health status/QoL—We used generic (i.e., non disease-specific) multi-item short-form measures of QoL and health status developed by PROMIS® available through their Assessment Center (<http://www.assessmentcenter.net/>) to assess global physical and mental health, anxiety, sleep disturbance, and ability to participate in social roles and activities with 4 items in each domain.^{31,32}

Asthma Severity was assessed by a single-item 5-point rating of the person-perceived severity of asthma in the past month in terms of “very mild” to “very severe.”

Demographics, health and service utilization—Person-reported information was collected on participant’s gender, race, ethnicity, age, and education level. We asked subjects about the number of asthma-specific overnight stays in a hospital and emergency room or urgent care center visits in the last year and whether or not a doctor or other health profession had ever told them that they had sinusitis, diabetes or high blood sugar, heart disease, chronic obstructive pulmonary disease, or migraine or other chronic severe headaches. Frequency of rescue inhaler use for quick relief from asthma symptoms during the past 4 weeks was assessed on a 5 point scale from “never” to “several times a day most days.” Use of controller medication was assessed by asking whether or not in the past 4 weeks the subject had taken a controller medication daily to protect their lungs and prevent asthma symptoms (*attacks*). Among those who reported “yes,” we asked, on average, how

¹Standardized IRT-based T-scores were generated from summed scores using procedures described by Thissen, Pommerich, Billeaud, and Williams (1995)²³ and later by Thissen and Wainer (2001).²⁴ For the RAND-IAQL-4 T-scores were fixed at “missing” for participants with one or more missing item responses to the 4-items; for participants with six or fewer missing responses to the 12-item RAND-IAQL-12, the mean on the completed item responses was imputed for missing values prior to obtaining the standardized T-score. For more examples of this scoring methodology see a number of papers describing PROMIS® item banking procedures.^{25,26}

many times a day they took their controller medication. Work/activity loss days were determined by asking how many days subjects were unable to work or carry out usual activities because of their asthma during the past 12 months.

Statistical Analysis

Descriptive analyses were conducted to examine asthma-specific QoL as measured by the RAND-IAQL-4 and RAND-IAQL-12 for the entire sample as well as by demographic subgroups. We expected that asthma-specific QoL would be lower in persons with less than a high school education and lower in Hispanics and African Americans than non-Hispanic Whites.^{33–35}

Construct validity was examined by looking at associations (Pearson's correlation coefficients and Spearman's rho (r_s) for single item variables) with related measures. We hypothesized that the RAND-IAQL-4 and IAQL-12 would correlate strongly with subject-reported single-item ratings of asthma severity and the extent to which asthma interferes with normal activities. We hypothesized that our measures would correlate highly with the Marks AQLQ total score and the four construct-specific sub-scales, but that the correlations would be stronger with the concerns, social and mood subscales than with the breathlessness subscale, which contains symptom items. We expected strong correlations with the generic PROMIS[®] QoL short-forms. Given that the impact of asthma has been shown to be greater on the physical functioning component of QoL than on mental functioning,^{36–38} we expected higher correlations with the PROMIS global physical health measure than with the PROMIS[®] global mental health measure.

Discriminant validity was examined by comparing the RAND IAQL-4 and RAND-IAQL-12 scores for respondents who differed according to indicators of asthma severity (number of asthma attacks), asthma control as measured by the ACT, presence or absence of co-morbid medical conditions, number of work/activity loss days, and measures of health care utilization. We expected the impact of asthma on QoL would be greater in persons with indicators of more uncontrolled asthma and more work days missed⁸ and in persons with greater health care utilization (more emergency room visits and hospitalizations for asthma during the past year and more frequent use of controller medications).

Tests of significance were calculated using t-tests for dichotomous variables or ANOVAs with Wald F-tests for differences among three or more groups. Post-hoc mean comparisons (Tukey) were calculated to test the significance of differences among pairs of groups and effect sizes were estimated using Cohen's *d*.³⁹ For Cohen's *d* an effect size of 0.2 to 0.3 is often considered a "small" effect, around 0.5 a "medium" effect, and 0.8 or greater a "large" effect.

Results

Our sample included a diverse group of 2032 people with asthma (Table 2). The mean age was 43 (range 18–99), 14% of whom were Hispanic, 11% Asian, 19% African American and 56% non-Hispanic White. Of those who identified as Hispanic, 46% were of Mexican origin, 20% Puerto Rican, 11% Cuban and 23% other Spanish origin. People were

distributed throughout the United States (about a quarter each in the East, Midwest, South and West). The sample was fairly highly educated with only 17% having less than or only a high school education. The sample included a range of asthma control levels with 38% having their asthma controlled, 22% somewhat controlled and 39% poorly controlled and according to the ACT. About 57% used a controller medication daily during the past 4 weeks to protect their lungs and prevent asthma symptoms and only 24% reported never using a rescue inhaler in the past 4 weeks.

Description of RAND-IAQL-4 and IAQL-12

Men reported significantly greater impact of asthma on their QoL than women (mean of 50.3 vs 49.1, $t=2.9$, $p=.004$ for IAQL-4 and mean of 50.6 vs 48.8, $t=4.0$, $p<.001$ for IAQL-12), although the effect size was small (.13 for IAQL-4; .18 for IAQL-12). As expected (Table 3), the negative impact of asthma on QoL was less for non-Hispanic Whites and worst in Hispanics (effect size .66 for IAQL-4; .75 for IAQL-12) and other minorities (effect size = .50 and .57 between Whites and African Americans and .34 and .39 between Whites and Asians, for IAQL-4 and IAQL-12 respectively). There was less negative impact of asthma on QoL as age increased (range of effects comparing age groups for IAQL-4 .08–.63 and .09–.60 for IAQL-12 with the largest differences between those aged 18–34 and aged 65+). In addition, more years of education was associated with less impact of asthma on QoL (range of effects comparing education groups for IAQL-4 .09–.42 and .10–.45 for IAQL-12 with the largest differences between those with a high school education or less and those with some graduate schooling).

Construct Validity

As hypothesized the RAND-IAQL-4 and IAQL-12 correlated strongly with a single-item self-reported rating of severity of asthma (Spearman's rho (r_s) = .59 and .63 with IAQL-4 and IAQL-12, respectively) and a single item person-reported rating of how much asthma interferes with normal activities (Spearman's rho (r_s) = .72 and .75, respectively). Correlations were high with the AQLQ-M total score (Pearson's r = .88 and .90 see Table 4). Slightly lower correlations were seen with the breathlessness and mood subscales than the concerns and social subscales. The IAQL-4 and IAQL-12 correlated less strongly with PROMIS® generic measures of QoL than with the AQLQ-M measure. Correlations with the PROMIS® generic QoL measures ranged from .39 to .70. Weakest correlations were with PROMIS® sleep disturbance and strongest correlations were with the PROMIS® measure of one's ability to participate in social roles and activities. As expected, the asthma-specific QoL short forms were more strongly correlated with PROMIS® physical measure than the general mental health measure.

Discriminant Validity

Table 5 shows the relationship between RAND-IAQL short-form scores and measures of health and asthma-related health care utilization. Mean asthma impact scores discriminated significantly between different levels of asthma-related health care utilization, presence versus absence of comorbid COPD, and levels of asthma control. Those who had an asthma attack in the past year had significantly greater impact of asthma on QoL than did those who

had not had an attack in the past year (effect sizes for IAQL-4 and IAQL-12 were 1.06 and 1.13, respectively); a similar result was found comparing those who had been hospitalized for asthma in the past year to those without a hospitalization (effect sizes = 1.28 and 1.38); comparing those who used controller medications daily to those who did not use controller medications (0.62 and 0.71), and comparing those with comorbid COPD to those without COPD (0.62 and 0.68). Effects sizes ranged from .39 to 1.70 comparing different numbers of attacks in past 4 weeks; .66 to 1.57 comparing number of times hospitalized in the past year; .38 to 1.85 comparing number of emergency department visits; .26 to 1.85 comparing number of times a day controller medications are used; and .65 to 1.73 comparing number of work loss days due to asthma in the past year. As presented previously, not only do impact scores decrease with increasing asthma control as defined by the ACT, but mean RAND-IAQL scores for those in the *somewhat controlled* ACT category are very close to 50, indicating that the mean RAND-IAQL score is comparable to the *somewhat controlled* ACT category. Further, the RAND-IAQL mean scores for the *poorly controlled* and *well controlled* ACT groups was symmetrically distributed around the mean of the *somewhat controlled* category (i.e., mean = 50, difference in scores is approximately ± 7 points, or .7 standard deviations), suggesting a linear relationship between the RAND-IAQL and ACT.¹⁹

Discussion

QoL is a key index of asthma's effect on individuals and improved QoL is a key goal of treatment. While a number of asthma-specific QoL instruments have been developed and used widely, available instruments often confound QoL with asthma symptom control and functional impairment.¹ To address this, we developed a more precise measurement of asthma QoL, the RAND-IAQL item bank and 4 and 12-item short forms, excluding symptoms and level of functional impairment and focusing explicitly on patient perceptions of how much they are impacted or bothered by their asthma. Previous reports supported the content validity of the item bank, which was generated from statements made by adults with asthma, supplemented by items from a review of the literature and from expert recommendations.¹⁸

However, before one can be confident that a measure should be used to assess asthma-specific QoL, evidence of its validity is required. This study provided initial information about how this new measure varies by demographic characteristics, and provided preliminary evidence to support the construct and discriminant validity of the two short-form measures, including information on how well asthma-specific QoL scores distinguish between different levels of asthma control. Because the short forms are comprised of items from the RAND-IAQL bank, any validity information obtained can be generalized to the full bank as well as any other assessments generated from the bank (e.g., CATs, tailored short forms).

The RAND-IAQL-4 and 12 had high correlations with the AQLQ-M, especially with the two subscales having content more likely to reflect the negative impact of asthma on QoL (the concerns and social subscales as opposed to the breathlessness and mood subscales) supporting the validity of our scale. The social/concerns subscales were shown to reflect a single factor in the modified version of the Marks Asthma QoL Questionnaire.⁶ High

correlations were expected, especially since one particular item included in the RAND-IAQL-12 was identical to a Marks item (Item 6 in Table 1). Correlations were lower with generic (PROMIS®) measures of QoL as expected. Highest correlations were with the generic measure of ability to participate in social roles and activities, highlighting the importance of this concept to perceived overall QoL in persons with asthma. Interestingly, weakest correlations were with the sleep disturbance short form which is considered one of the core indicators considered when determining asthma control. This may be due to the fact that the PROMIS® sleep disturbance measure was defined in terms of the quality of the sleep (e.g., sleep was refreshing, sleep quality was poor) rather than in terms of awakening due to asthma symptoms. This suggests that non-specific sleep disturbance is not a very good indicator of the impact of asthma on QoL.

The RAND-IAQL-4 and 12 showed clear evidence of discriminant validity. Both short forms were able to differentiate between adults with asthma according to their self-perceived severity, level of asthma control, presence or absence of exacerbations (e.g., number of asthma attacks, hospitalizations and ER visits), and physical comorbidity. These results help to interpret the meaning of scores. Based on separate regression analyses, only 35–40% of the variance in the RAND-IAQL-4 and 12 was explained by a single-item rating of self-perceived severity of asthma supporting the idea that these two concepts (self-perceived asthma severity and self-perceived burden of asthma on aspects of their everyday life) are not synonymous.

A limitation of the study is that it was conducted via an online internet sample who may differ from patients with asthma seen in clinical settings. However, the sample was comprised of individuals from diverse demographic backgrounds, representative of areas across the United States, and varied across a range of self-reported asthma control. Diagnosis of asthma and select other medical conditions was self-report and not confirmed independently by clinician report. Thus, we cannot be sure that there was not some misdiagnosis of asthma. While each QoL item asked whether the burden was due to asthma, future research should evaluate the measures in well-defined clinical populations. To assure variability across a range of asthma severity, we required that 90% of the sample had experienced an episode of asthma or an attack in the prior 12 months. Thus, our sample may reflect a more severe and poorly managed group than those in the general asthma population. However, self-ratings of asthma severity were low. It is possible that this discrepancy could have biased results through underestimation of known group differences such as differences in asthma-specific QoL between those who were poorly, somewhat or well-controlled. Although effect sizes may be slightly underestimated, the statistical inferences do not seem to have been affected by the low self-ratings of severity in our sample. We suspect that the low self-ratings may be due to the fact that some people had adapted to their asthma and habituated to a lower QoL. How we might adapt QoL measurement to address adaptation to asthma is an important direction for future research.

We included subjects with comorbidity in our sample in order to develop a generalizable tool that could be used in clinical applications and effectiveness studies which include more heterogeneous samples than those typically seen in efficacy studies of specific treatments. Specifically, comorbid COPD is often excluded in asthma clinical trials. To explore the

extent to which our analyses may have been influenced by comorbid COPD, we repeated the analyses excluding the small subgroup of asthmatic individuals who also reported having COPD. Correlations and score levels were similar and differences among groups remained significant even with the exclusion of this group. Further study is needed to examine whether our measures apply equally well to people with COPD alone.

Our analyses represent the first step in showing the validity of the RAND-IAQL toolkit. Next steps include evaluating our measures in well-defined clinical populations and estimating minimally important differences and responsiveness to change in clinical outcomes. To aid in interpretation, we also recommend linking scores (e.g., to use scores on one measure to describe scores on another measure) from the RAND-IAQL to other commonly used Asthma-specific QoL measures.⁴⁰ The RAND-IAQL toolkit also needs to be adapted and evaluated for use in non-English speaking populations.

Evidence from this study suggests that the RAND-IAQL bank and its short forms show promise as a new tool designed to reduce respondent burden yet provide precise estimates of the impact of asthma on a person's QoL. The strong psychometric properties reported in Stucky et al., 2014¹⁹ and the encouraging validity preliminary evidence reported in this manuscript support the more widespread use of this measure.

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Abbreviations

ACT	Asthma Control Test
CAT	Computer Adaptive Test
IRT	Item Response Theory
M-AQLQ	Marks' Quality of Life Questionnaire
QoL	Quality of Life
RAND-IAQL-4	RAND Negative Impact of Asthma on Quality of Life 4-item Short Form
RAND-IAQL-12	RAND Negative Impact of Asthma on Quality of Life 12-item Short Form

**RAND-IAQL-
BANK****RAND Negative Impact of Asthma on Quality of Life Item Bank****References**

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Key Messages

The RAND-IAQL is a valid gauge of an individual's perceptions of the impact or bother of asthma and its treatment on his or her life.

Table 1
Content of RAND-IAQL-4 and RAND-IAQL-12 Short Forms

The following statements are about how asthma affects the quality of your life. For each statement, please give the one answer that comes closest to the way asthma has affected your life.

In the <u>past 4 weeks</u> , I worried about the long-term effects of asthma on my health
In the <u>past 4 weeks</u> , I had to worry about asthma triggers*
In the <u>past 4 weeks</u> , my asthma was on my mind
In the <u>past 4 weeks</u> , it was hard to get a good night's sleep because of my asthma
In the <u>past 4 weeks</u> , I felt like I couldn't enjoy life because of my asthma*
In the <u>past 4 weeks</u> , I felt that asthma was controlling my life
In the <u>past 4 weeks</u> , I felt frustrated that I couldn't make plans in advance because of my asthma
In the <u>past 4 weeks</u> , because of my asthma, everyday activities were a struggle
In the <u>past 4 weeks</u> , asthma placed stress on my relationships with family, friends, significant others, or co-workers
In the <u>past 4 weeks</u> , because of my asthma, I felt frustrated that I have to do things differently than people who don't have asthma*
In the <u>past 4 weeks</u> , I felt like I missed out on doing things with others because of my asthma*
In the <u>past 4 weeks</u> , because of my asthma, I had to do a lot of planning to make sure I always had an inhaler ready

* Questions include in the RAND-IAQL-4

Response choices: (Not at all = 0, A little bit = 1, Somewhat = 2, Quite a bit = 3, Very Much = 4)

Table 2

Demographic Characteristics of Asthma Sample (N=2032)

	Median or N(%)
Median Age (Interquartile percent)	42 (24)
Gender	
Female	1219(60)
Ethnicity/Race	
Hispanic	282(14)
Asian	221(11)
African American	381(19)
Non-Hispanic White	1148 (56)
Region of US	
East	478(24)
Midwest	432(21)
South	578(28)
West	544(27)
Education	
<= High School	353(17)
Some college	743(36)
College Graduate	490(24)
Some Graduate school or grad degree	446(22)
Medical Comorbidities	
Sinusitis	1284(63)
Diabetes	505(25)
Heart Disease	194(9)
COPD	287(14)
Migraine headaches	660(32)
Hospital Stay past year	385(19)
Emergency visits for Asthma in past year	
0	1248(61)
1	282(14)
2	204(10)
3+	297(15)
Self-Rating of Asthma Severity	
Very mild	383(19)
Mild	580(28)
Moderate	824(41)
Severe	207(10)
Very Severe	36(2)
Frequency used rescue inhaler past 4 weeks	

	Median or N(%)
Never	495(24)
1 time per week	510(25)
2 or more times per week but not daily	600(29)
Daily	279(14)
Several times a day most days	143(7)
Used controller medication daily in the past 4 weeks	1163(57)
Asthma Control Test level	
Controlled (20+)	770(38)
Somewhat Controlled (16–19)	446(22)
Poorly Controlled (5–15)	796(39)

Table 3

RAND 4 and 12-item QoL scores by Demographic Groups

Race/Ethnicity	Mean (SD)	Differences Between Races			
		Hispanic (p-value)	African American (p-value)	Asian (p-value)	Non-Hispanic White (p-value)
		F=46.1(p<.001) for RAND-IAQL-4 F=60.4(p<.001) for RAND-IAQL-12			
Hispanic	53.5(9.2) 54.2(9.6)	--	.17 .08	.003 <.001	<.001 <.001
African American	52.1(8.9) 52.4(9.2)	--	--	.26 .18	<.001 <.001
Asian	50.7(9.7) 50.8(9.9)	--	--	--	<.001 <.001
Non-Hispanic White	47.6(9.0) 47.2(9.3)	--	--	--	--
Education		Differences between educational levels			
		F=16.6(p<.001) for RAND-IAQL-4 F=18.9(p<.001) for RAND-IAQL-12			
< High School	51.5(9.6) 51.6(10.1)	--	.34 .43	<.001 <.001	<.001 <.001
Some College	50.5(9.0) 50.6(9.2)	--	--	<.001 .002	<.001 <.001
College Graduate	48.5(9.6) 48.6(10.1)	--	--	--	.50 .11
Some Grad school or grad degree	47.6(9.1) 47.2(9.6)	--	--	--	--
Age Group		Differences between age groups			
		F=24.3(p<.001) for RAND-IAQL-4 F=23.7(p<.001) for RAND-IAQL-12			
		18-34 (p-value)	35-49 (p-value)	50-64 (p-value)	65+ (p-value)
18-34	51.8(9.3) 51.8(9.9)	--	<.001 <.001	.001 <.001	<.001 <.001
35-49	49.2(9.7) 49.1(10.2)	--	--	.46 .46	<.001 <.001
50-64	48.4(8.7) 48.3(8.8)	--	--	--	.03 .05

Race/Ethnicity	RAND-IAQL-4 RAND-IAQL-12	Differences Between Races		
65+	46.1(8.6) 46.0(8.9)			--

Significance values are based on the Tukey-Kramer correction for multiple comparisons.

Table 4

Correlations of RAND IAQL-4 and IAQL-12 Scores with Marks AQLQ and PROMIS Generic QoL Measures

	IAQL-4 (95% CI)	IAQL-12 (95% CI)
<i>Marks Asthma Quality of Life Questionnaire (AQLQ-M)</i>		
Total Scale	.88 (.86 to .88)	.90 (.89 to .91)
Breathlessness subscale	.80 (.78 to .81)	.84 (.82 to .85)
Concerns subscale	.86 (.85 to .87)	.88 (.87 to .89)
Mood subscale	.78 (.76 to .80)	.81 (.79 to .82)
Social subscale	.87 (.86 to .88)	.87 (.86 to .88)
<i>PROMIS Generic Quality of Life Measures</i>		
Global Physical Health	-.54 (-.57 to -.51)	-.57 (-.60 to -.54)
Global Mental Health	-.42 (-.46 to -.39)	-.43 (-.46 to -.39)
Ability to Participate in Social Roles/Activities	-.69 (-.71 to -.66)	-.70 (-.72 to -.68)
Anxiety	.61 (.58 to .64)	.63 (.60 to .65)
Sleep Disturbance	.39 (.36 to .43)	.42 (.38 to .45)

Note: Higher scores on the PROMIS® Global Physical and Mental Health short forms and the Ability to Participate in Social Roles/Activities short form indicates better QoL.

Table 5

RAND 4 and 12-item IAQL scores by Health Characteristics and Service Use

Health Characteristics	RAND IAQL-4 (High score = more impact)	RAND IAQL -12 (High score = more impact)	F or t-test (IAQL- 4/ IAQL-12) (p)
	Mean (SD)	Mean (SD)	
Had asthma attack past year			t=14.1(p<.001) t=15.1(p<.001)
Yes	50.5(9.2)	50.6(9.5)	
No	41.0(6.2)	40.1(6.8)	
Number of attacks past 4 weeks ^a			F=251.2(p<.001) F=301.0(p<.001)
0	44.1(7.4)	43.5(7.8)	
1	48.7(9.0)	48.4(8.8)	
2-4	51.9(8.0)	52.3(8.2)	
5+	56.4(8.5)	57.0(8.3)	
Hospitalized for Asthma past year			t=22.2(p<.001) t=24.3(p<.001)
Yes	58.2(7.4)	59.1(7.8)	
No	47.5(8.6)	47.2(8.8)	
Number of Times Hospitalized past year^d			F=263.1(p<.001) F=305.2(p<.001)
0	47.5(8.6)	47.2(8.8)	
1	54.7(8.9)	55.6(9.6)	
2+	59.6(6.2)	60.5(6.5)	
Number of ER Visits past year ^a			F=279.5(p<.001) F=352.6(p<.001)
0	45.8(7.7)	45.2(7.9)	
1	52.5(8.7)	52.8(8.6)	
2	55.7(8.2)	56.5(7.9)	
3+	58.7(7.3)	59.7(7.4)	
Used controller med daily past 4 weeks			t=13.6(p<.001) t=15.7(p<.001)
Yes	51.9(9.3)	52.3(9.5)	
No	46.4(8.5)	45.8(8.9)	
Number times/day take controller meds ^a			F=69.3(p<.001) F=81.0(p<.001)
0	46.4(8.5)	45.8(8.9)	
1	48.6(8.2)	48.9(8.2)	
2	52.1(9.2)	52.3(9.1)	
3+	58.7(8.2)	59.8(8.6)	
Has COPD			t=9.7(p<.001) t=10.6(p<.001)
Yes	54.5(9.0)	55.1(9.0)	

Health Characteristics	RAND IAQL-4 (High score = more impact)	RAND IAQL -12 (High score = more impact)	F or t-test (IAQL- 4/ IAQL-12) (p)
	Mean (SD)	Mean (SD)	
No	48.8(9.2)	48.6(9.6)	
Number of days unable to work past year due to asthma ^a			F=429.2(p<.001) F=502.7(p<.001)
0	42.9(6.5)	42.2(6.8)	
1-5	49.4(8.7)	49.3(9.0)	
6+	54.9(8.2)	55.4(8.2)	
Asthma Control (ACT)^a			F=707.3(p<.001) F=1007.2(p<.001)
Poorly controlled	56.4(8.0)	57.3(7.5)	
Somewhat controlled	49.4(7.2)	49.5(6.7)	
Well Controlled	42.7(6.2)	41.6(6.4)	

^aPost-hoc comparisons indicate that all control categories are significantly different from each other