

Original article

Evaluation of the Asthma Life Quality test for the screening and severity assessment of asthma

Background: Asthma Life Quality (ALQ) test, a 20-question questionnaire developed by the American College of Allergy, Asthma and Immunology, has been shown to be useful for asthma diagnosis. We aimed to determine the relation between ALQ scores and (a) diagnosis of asthma; (b) physician's classification of asthma severity according to National Institutes of Health/Global Initiative for Asthma (GINA).

Methods: Standard translation and cultural adaptation to Portuguese was performed. Patients self-administered the ALQ in the waiting room; the attending allergist classified them, blindly for the test. The scores of nonasthmatics were compared with those of asthma patients. Asthma patients were analyzed in two severity groups: intermittent and mild persistent asthma (IMPA), and moderate and severe persistent asthma (MSPA); sensitivity, specificity, positive and negative predictive values were calculated and receiver operating characteristic curve plotted. Logistic regression analysis models were computed.

Results: From 283 patients, 237 tests were analyzed. Non-asthmatic patients ALQ scores (mean $\pm$ SD) were 6 ± 4 and, for asthmatics, 10 ± 5 [mean difference 4.6 (95%CI 3.3–5.9)]. The odds of positive diagnosis increased 1.27 times (95%CI 1.17–1.38) for each one-unit increase in the test. For asthma severity ALQ scores were 9 ± 4 for IMPA, 15 ± 3 for MSPA [difference 6.0 (95%CI 4.8–7.1)]; with a sensitivity of 88% and specificity of 74% for a score of 12. The odds of MSPA increased 1.49 times (95%CI 1.28–1.74) per unit increase in ALQ.

Conclusions: ALQ can help both to identify patients with asthma and to differentiate those more likely to have moderate/severe asthma. These are relevant characteristics for the possible use of this simple, self-administered questionnaire in the assessment of asthma patients needing additional medical management.

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Asthma, a major health problem in most parts of the world, is still under-diagnosed and under-treated (1). Public awareness, education campaigns and screening programs for populations at special risk are considered useful initiatives for improving asthma care (1–3).

It is well recognized that different groups of asthma patients have different treatment needs. The National Institutes of Health (NIH)/Global Initiative for Asthma (GINA) guidelines (1) recommend referring to specialized care patients with specific criteria, such as patients with moderate or severe persistent asthma. Most patients have mild asthma but in more severe patients, asthma represents a substantial social and personal burden (4), responsible for a disproportional use of health care resources (5) and may have a higher risk of under-treatment (6).

With the evolution of health care the explicit assessment of chronic diseases' impact in patients' lives is increasingly relevant. In asthma, humanistic outcomes

such as disease specific health-related quality of Life are well established in clinical research (7), but still with undetermined value in daily practice (8).

The Asthma Life Quality (ALQ) test is a simple self-administered questionnaire designed to help individuals with breathing problems determine if they have asthma or, for those already diagnosed with asthma, if their asthma is under control. It was developed by the American College of Allergy, Asthma and Immunology (ACAAI) and has been shown to be useful and valid as an asthma-screening tool (9). This test has been administered to an estimated 30 000 participants in ACAAI screening programs (which also included a lung function test and a meeting with an allergist). One goal of these screenings programs is to determine if participants should be referred for professional evaluation.

The ALQ is simple and fast to fill. It is readily available in different media including the world wide web (10). If its ability to recognize asthma patients with different disease

severities is established, it could help to improve appropriate care, by identifying asthma's impact on patient's life and to facilitate the reference to specialized asthma management programs.

The purpose of this study was to evaluate the relation between the scores of the Portuguese version of the ALQ test with the clinical diagnosis of asthma and with the physician's classification of asthma severity, according to NIH/GINA guidelines criteria.

Methods

The ALQ comprises 20 questions in yes/no answer format. It addresses six dimensions of asthma's impact in patients' lives: (i) activity and sleep, (ii) symptoms, (iii) triggers, (iv) unscheduled health care use (v) medication and (vi) psychological. All questions have equal weight and, for each patient, a total ALQ score is calculated as the sum of all positive (Yes) responses, ranging from 0 to 20.

Translation and adaptation to Portuguese

The ALQ Portuguese version was translated and adapted (9), after author consent, according to usual methods. Three different translations were independently carried out. The authors compared these translations and a consensual version was tested in a pilot study – 25 asthma patients who were questioned for comprehension and adequacy of the questions. This pilot study indicated the need to change the wording of two questions. This second version of ALQ was used previously in a cross-sectional survey of one hundred members of an asthma patient association (11). The internal consistency of ALQ was good (Cronbach's alpha 0.84), the reproducibility was not studied (11). Back translation to English was also made and the versions were considered similar by the authors.

Setting, population and data gathering

During a period of 2 weeks, the questionnaire was prospectively given to a convenience sample of patients who were attending three different asthma and allergy clinics (at a university hospital, at a district hospital and at a small town clinic) for a scheduled appointment with an allergist.

The data-form gathered similar information as the collected in the study by Winder et al. (9). Along with the ALQ, the patients were asked to record their name, date of birth and gender on the questionnaire.

The patients self-administered the ALQ while in the waiting room. Subsequently, the attending allergist blindly classified the patients in five groups: not having asthma (NA), intermittent asthma (IA), mild persistent (MiP), moderate persistent (MoP) and severe persistent (SP) asthma.

This classification was based on a detailed medical history, physical examination, measurement of forced expiratory volume 1 s (FEV₁) or peak expiratory flow (PEF) and previous medication, according to the NIH/GINA asthma guidelines. The severity assessment, from intermittent to severe persistent asthma, was based on daytime symptoms, nighttime symptoms, frequency and intensity of attacks, impact on daily activities, asthma treatments used and predicted percentage of FEV₁ or PEF. A trained allergist observed all the patients included in each of the allergy clinics.

Statistical analysis

Age and ALQ score were expressed as mean $\pm$ standard deviation (SD), and sex as number of cases (*n*) and percentage (%).

The classification made by the physician was recoded as non-asthmatic patients and asthmatic patients. For data analysis intermittent and mild persistent asthma (IMPA) were aggregated and compared with the moderate persistent and severe persistent (MSPA) group.

The associations between diagnosis and classification of asthma, sex and ALQ items were analyzed using Chi-square tests; *t*-test was used to compare ALQ scores and age between patients with and without asthma and between the two groups of asthma severity (IMPA and MSPA). The Pearson linear regression coefficient was computed to measure the association between age and ALQ score.

Pretest probability (prevalence of MSPA in the study population) was calculated from physician classification. Test performance was computed using sensitivity, specificity, and predictive value for a positive and for a negative test. Receiver operating characteristic (ROC) curve was plotted, allowing a graphical representation of sensitivity and specificity.

Multivariable logistic regression was used to compute the probability of asthma diagnosis by ALQ score and age. Hosmer–Lemeshow goodness-of-fit test was performed (12). The same methodology was used for the asthma severity groups. For all statistics tests the significance level was 5%. Statistical analysis was performed using Statistical Package for Social Sciences® (Chicago, IL) v. 11.0.

Results

From the 283 administered tests, 237 (84%) fully completed questionnaires were analyzed. Ninety (38%) were observed at the university hospital, 74 (31%) at the district hospital and 73 (31%) at the small town ambulatory clinic.

Of the 176 (74%) patients diagnosed with asthma, severity was classified as intermittent in 82 (47%), mild persistent in 51 (29%), moderate persistent in 34 (19%) and severe persistent in nine (5%) patients. Seventeen were given an asthma diagnosis for the first time at study visit. For each severity step mean ALQ scores were: intermittent asthma 8 ± 4 , mild persistent 11 ± 4 , moderate persistent 14 ± 3 , and severe persistent 17 ± 3 (Fig. 1). ALQ scores showed a symmetric distribution. ALQ scores were significantly higher in females, (mean 10 ± 5 vs 8 ± 5 , $P < 0.001$). The linear regression coefficient between age and ALQ was 0.381 ($P < 0.001$).

In Table 1 the patient characteristics and ALQ scores are presented for the different groups analyzed: patients with or without asthma diagnosis and, for asthma patients, severity classification groups – IMPA and MSPA.

The percentages of positive answers to each question of ALQ are presented in Table 2. Except for the medication dimension, statistical significant differences were found for the other five dimensions and for all individual questions between nonasthma and asthma patients. When

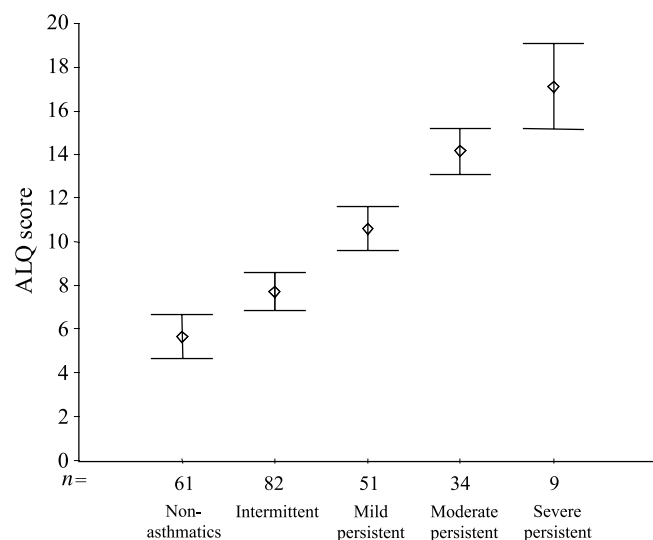


Figure 1. Confidence intervals (95%) of Asthma Life Quality scores for patients without asthma and with the different NIH/GINA asthma severity steps.

looking at asthma patients classified by severity (IMPA and MSPA) all, except the symptoms and triggers dimensions as well as a question regarding medication (*My asthma medicine doesn't control my asthma*), were statistically significant.

Asthma diagnosis

Mean ALQ score for nonasthmatic patients was 6 ± 4 and for all asthmatics 10 ± 5 . A difference of 4.6 units (95%CI ranged between 3.3 and 5.9) was observed in the mean ALQ scores between those groups (i.e. asthma patients scored, on mean, 4.6 points higher than non-asthma patients, $P < 0.001$).

We also used logistic regression analysis (9) to confirm that a higher ALQ score is associated with a higher

likelihood of a positive diagnosis. For the diagnosis of asthma the odds of a positive diagnosis increased 1.27 times (95%CI 1.17–1.38) for each one-unit increase in the test score, adjusted for age. A case was classified as positive if the predicted probability of asthma diagnosis was 0.42 or greater. The model correctly classified 79% of the patients. Only four of the 176 patients diagnosed with asthma by the physician were not predicted to have asthma by the test model. In contrast, 45 of 61 non-asthma patients were classified as asthma patients in this model.

Asthma severity

The ALQ scores were 9 ± 4 for IMPA and 15 ± 3 for MSPA with a statistically significant mean difference between groups of 6.0 (95%CI 4.8–7.1).

In our study population the prevalence of MSPA was 24%. Figure 2 presents the ALQ test ROC curve regarding the asthma severity groups. The ROC area under the curve was 0.87 (95%CI 0.82–0.93). Also listed in Table 3 are the values of sensibility, specificity, positive and negative predicted values of selected cutoff points of ALQ score. A cutoff point of 6 in the ALQ test score was associated with maximal sensitivity but with low specificity. The specificity was maximum at a score of 17 but sensitivity was low. A score of 12 had the best balance between sensitivity and specificity, with values of 88 and 74% respectively.

Using multivariable logistic regression analysis, the odds of MSPA classification increased 1.49 times (95%CI 1.28–1.74) for each one-unit increase in the ALQ score, and increased 1.06 times (95% C.I. 1.03–1.10) for each 1-year increase in the patient age. The variation of ALQ scores is explained in 57% by severity classification (IMPA/MSPA) and age.

Considering the predicted probability cut value 0.33, the model correctly classified 86% of the patients, with a sensitivity of 81% and a specificity of 88%. The model

Table 1. Description of patient characteristics and Asthma Life Quality (ALQ) scores in the different patient groups

	Total (n = 237)	Diagnosis			Severity		
		Nonasthmatics (n = 61)	Asthmatics (n = 176)	P-value	Intermittent & mild persistent (n = 133)	Moderate & severe persistent (n = 43)	P-value
Sex n (%)				0.552*			0.274*
Male	97 (41)	23 (38)	74 (42)		59 (44)	15 (35)	
Female	140 (59)	38 (62)	102 (58)		74 (56)	28 (65)	
Age mean (SD)	29 (16)	26 (12)	30 (17)	0.063†	26 (13)	45 (17)	<0.001†
ALQ score							
Mean (SD)	9 (5)	6 (4)	10 (5)		9 (4)	15 (3)	
Median	9	5	11	<0.001†	9	15	<0.001†
Min (n)–max (n)	0 (3)–20 (2)	0 (2)–16 (1)	0 (1)–20 (2)		0 (1)–16 (5)	6 (1)–20 (2)	
95% confidence interval (mean)	8.4–9.7	4.6–6.6	9.6–11.0		8.1–9.5	13.8–15.7	

* Pearson chi-square test.

† t-Test; n – number of patients.

Table 2. Percentages of positive answers to the Asthma Life Quality (ALQ) test and for the six dimensions of the test, in the patient groups

ALQ		Diagnosis			Severity		
		Total (n = 237)	Non-Asthmatics (n = 61)	Asthmatics (n = 176)	P-value*	Intermittent & mild persistent (n = 133)	Moderate & severe persistent (n = 43)
Activity and sleep	When I walk or do simple chores. I have trouble breathing or I cough	31	18	36	0.010	23	77
	When I perform heavier work, such as walking up hills and stairs or doing chores that involve lifting, I have trouble breathing or I cough	55	36	61	0.001	52	91
	Sometimes I avoid exercising or taking part in sports like jogging, swimming, tennis or aerobics because I have trouble breathing or I cough	46	25	54	<0.001	44	84
	I have been unable to sleep through the night without coughing attacks or shortness of breath	44	23	51	<0.001	41	84
	<i>At least one positive answer in this group</i>	73	52	80	<0.001	73	100
	Symptoms						
	Sometimes I can't catch a good, deep breath	60	44	65	0.004	58	88
	Sometimes I make wheezing sounds in my chest	71	33	85	<0.001	82	93
	Sometimes my chest feels tight	57	34	65	<0.001	57	88
	Sometimes I cough a lot	49	30	56	<0.001	47	81
Triggers	<i>At least one positive answer in this group</i>	89	72	95	<0.001	94	100
	Triggers						
	Dust, pollen and pets make my asthma worse	68	49	75	<0.001	75	74
	My asthma gets worse in cold weather	46	23	54	<0.001	47	74
	My asthma gets worse when I'm around tobacco smoke, fumes and strong odors	68	43	77	<0.001	71	98
	When I catch a cold, it often goes into my chest	65	36	74	<0.001	70	88
	<i>At least one positive answer in this group</i>	88	67	95	<0.001	93	100
	Unscheduled health care utilization last year						
	I made one or more emergency visits due to asthma or breathing problems in the last year	27	8	34	<0.001	24	65
	I had one or more overnight hospitalizations due to asthma or breathing problems in the last year	11	2	14	0.007	6	40
Medication	<i>At least one positive answer in this group</i>	28	10	35	<0.001	25	65
	Medication						
	I feel like I use my asthma inhaler too often	20	7	24	0.003	17	49
	Sometimes I don't like the way my asthma medicine(s) makes me feel	9	2	11	0.021	7	26
	My asthma medicine doesn't control my asthma	28	46	22	<0.001	20	28
	<i>At least one positive answer in this group</i>	46	52	44	0.272	38	65
	Psychological						
	My breathing problem or asthma controls my life more than I would like	54	39	60	0.006	47	98
	I feel tension or stress because of my breathing problem or asthma	43	31	47	0.036	38	74
	I worry that my breathing problem or asthma affects my health or may even shorten my life	55	36	62	<0.001	57	77
	<i>At least one positive answer in this group</i>	73	54	79	<0.001	72	100

* Pearson chi-square test.

† Fisher's exact test.

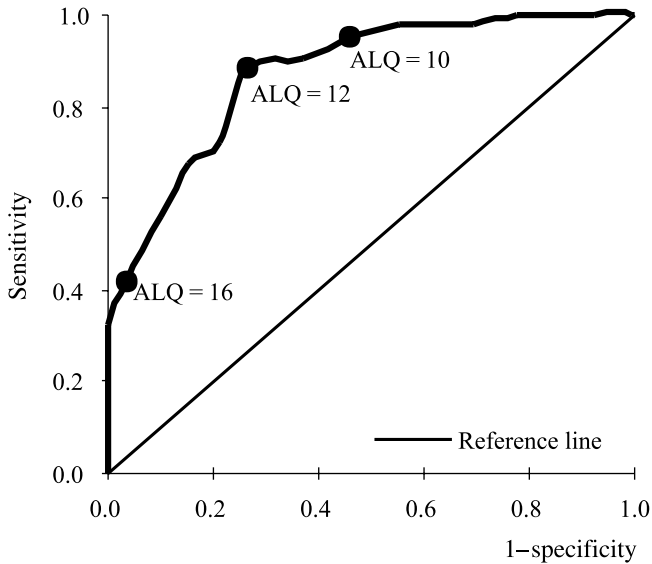


Figure 2. Receiver operating characteristic curve of the sensitivity and specificity for the Asthma Life Quality score in the classification of asthma severity (moderate/severe persistent asthma). Area under the curve 0.87 (95% CI 0.82–0.93).

Table 3. Sensitivity, specificity, positive predicted value (PPV) and negative predicted value (NPV) of different Asthma Life Quality scores for moderate/severe persistent asthma classification

Positive if equal or greater than	Sensitivity	Specificity	PPV	NPV
6	100	23	29	100
7	98	31	31	98
8	98	35	33	98
9	98	45	37	98
10	95	54	40	97
11	91	63	44	95
12	88	74	52	95
13	72	79	53	90
14	67	85	59	89
15	56	90	65	86
16	42	96	78	84
17	33	100	100	82

misclassified only 16 of the 133 patients rated by the physician as IMPA. Of the 43 patients rated as MSPA by the physician, the model identified 35 of them correctly.

Discussion

Our data showed that the Portuguese version of ACAAI ‘Life Quality Test’ (ALQ) is a good tool to help predict which individuals are more likely to be diagnosed with asthma, in agreement with previous findings from a different cultural and social background (9). Moreover, we were able to demonstrate that ALQ test is also useful

to predict whether an individual will be assigned to the MSPA steps of the NIH/GINA classification.

As in the work by Winder et al. (9), we have showed that a logistic regression model with ALQ score and age can correctly classify a considerable (79%) proportion of patients with regard to asthma diagnosis. A considerable difference (4.6 units in a score range 0–20) was observed in the mean ALQ scores between nonasthmatic and asthmatic patients. The results indicate ALQ test as a good first step in asthma screening with a low number of missed cases (four of 176). Nevertheless, a medical interview is necessary for diagnosis confirmation (as indicated by the considerable number of false positives).

The aim of Winder et al.’s study (9) was to determine if a high score on the ALQ was a positive predictor for the diagnosis of asthma but in our work we further analyze the ability of ALQ score to predict a classification of moderate/severe asthma, in order to identify patients who may benefit from a more thorough management. The methodological differences in the two studies are because of this objective. Winder et al. administered the test to patients of both an allergy clinic and a dental office (who were considered controls). For the purposes of our study, the ability to discriminate between patients seen at allergy clinics is particularly relevant as it may be more difficult to predict asthma diagnosis and severity in those patients, than in individuals attending health care facilities because of problems unrelated to asthma. These allergy clinic patients may have nonasthma breathing difficulties or misperception of breathing problems as mention by Winder et al. (9).

The other methodological difference with the study by Winder et al. (9) was the sample selection. In our study, during a 2-week period, patients attending the allergy clinic for scheduled appointments were eligible for participation, regardless of previous observations at the clinic, whereas, in the previous study, patients were observed sequentially, in their first visit. If ALQ is to be used for assessment of patients with moderate/severe asthma attending an outpatient service, the sample method we used mimics this scenario. Also, previous observations of the patient and/or the notes on the medical record could influence the classification made by the physician. However this would probably improve the accuracy of classification, and therefore its effect would be beneficial to the study.

Our data clearly shows the ability of ALQ test to discriminate between asthma patients classified by their doctors as MSPA from those with an intermittent and mild persistent classification. The mean difference between IMPA and MSPA ALQ scores was 6.0 (95% C.I. 4.8–7.1), which is considerable in a test with a range of 21 units.

The ROC area under the curve was also noteworthy, 0.87 (95% C.I. 0.82–0.93). Choosing the optimal cut-off value of the test score is a trade-off between optimizing sensitivity and specificity. The optimal decision threshold

depends considerably on the specific clinical application in which the test is used. At a cut-off value of 10 which was the mean score of our asthmatic patients, the sensitivity was high (95%) but specificity was low (54%). A higher cut-off value (16) increases specificity up to nearly maximum (96%) levels but sensitivity is quite low (42%). At an ALQ score of 12 the sensitivity and specificity values (88 and 74%, respectively) are optimally balanced.

The regression analysis model also indicates the good ability of ALQ score to predict an MSPA classification. This was further improved by including patient age in the model. The odds increased approximately 1.5 times for each one-unit increase in the test score. The percentage of patients correctly classified by the model's predicted probabilities was good (86%). The low number of false positive results (16 of 133) points towards the ability of ALQ to exclude patients with low asthma morbidity (those classified in Intermittent and mild persistent severity steps). These are the majority of asthma patients and generally do not need specialized interventions.

In the severity regression model, the odds of MSPA classification increased 1.06 times (95% CI 1.03–1.10) for each 1-year increase in the patient age. This small effect has an opposite direction of effect described for asthma diagnosis (9). However, the observation that older age groups have more severe asthma is common in clinical practice and also established in some studies (13, 14).

In order to be useful for decision making at the individual patient level, surveys require minimal ceiling and floor effects (the percent of patients scoring at the best and worst possible levels, respectively) which was the case in this study, as shown in Table 1.

For patients previously diagnosed with asthma, the ALQ test was designed by ACAAI in order to provide information on asthma control. The association we observed between severity classification and the ALQ score may suggest a possible relation with asthma control. This would be best established in a prospective study, although the relatively un-defined time frames of some ALQ questions may constitute a problem for its use in the evaluation of asthma control.

Some authors state the difficulty to distinguish between asthma severity and asthma control (15). Current emphasis is given to the translation of the treatment goals into guideline-based composite measures of overall asthma control, providing quantitative data useful for a pragmatic clinical interpretation (16). Questionnaires specifically developed, such as the Asthma Control Questionnaire of Juniper et al. (17), may also prove adequate to evaluate asthma control over time.

Consistent approaches to measure the patient's perspective during routine clinical visits may improve clinical records' data and allow the development of a medical plan directed at patient-reported functioning and well being. However, there are several practical challenges and difficulties to this approach (18), and it is still necessary to assess its usefulness in day-to-day practice. The need for simple tools for the identification of under-treated asthma has also been highlighted (6).

In conclusion, the ACAAI Asthma Life Quality is a straightforward self-administered test that, can help identify patients with asthma and, from this group, distinguish those more likely to have moderate/severe asthma. These are relevant characteristics for the possible use of this questionnaire as a first-step in identifying asthma patients needing additional or specialized medical management.

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Conflict of interest

Participating institutions (Hospital S. Joao & Faculdade de Medicina da Universidade do Porto) provided all the financial support for this study. No conflict of interests to report.

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