






















## Original Article

# Validity and Reliability of the Assessment Tool for Asthma (ATA) Questionnaire: the ATA Study

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## Abstract

**OBJECTIVES:** A multicenter trial was designed to validate the “Assessment Tools for Asthma (ATA)” questionnaire, a newly developed questionnaire, which evaluates both asthma control and risk factors associated with asthma control with a single instrument.

**MATERIALS AND METHODS:** This cross-sectional study involved 810 cases from 14 clinics in 9 Turkish cities. The ATA questionnaire and Asthma Control Test (ACT) were administered. The Visual Analog Scale (VAS) was used to evaluate the control status of 100 randomized cases. ATA is an eight-item physician-administered questionnaire. It comprises the following two sections-ATA1, assesses symptomatic control criteria, and the remaining section, queries the flare-up of asthma, control of comorbidities, treatment adherence, and inhaler technique.

**RESULTS:** The mean scores for ATA1, ATA total, VAS, and ACT were 24.7±14.8, 53.8±19, 7.1±3, and 18.8±5.5, respectively. According to the ATA questionnaire, among all patients, 34.3% had controlled, 18.8% had partly controlled, and 46.9% had uncontrolled asthma. Furthermore, 16.6% patients had flare-ups between visits, 96.4% patients had uncontrolled comorbidity, 17% patients had irregular asthma treatment, and only 8.4% patients used the incorrect inhaler technique. The ATA questionnaire showed internal consistency (Cronbach’s alpha coefficient=0.683). ACT, ATA1, and two specialists’ evaluations using VAS correlated strongly with the ATA total scores (Spearman correlation coefficient (r) values: 0.776, 0.783, and 0.909, respectively; p-values: p<0.001, p<0.001, and p<0.001, respectively). According to Receiver Operating Characteristic analysis, the cut-off value of ATA was 50 (sensitivity=84.4%, specificity=82.40%).

**CONCLUSION:** The validated ATA questionnaire may be a practical tool for physicians in asthma management.

**KEYWORDS:** Allergy, asthma, asthma control, questionnaire

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## INTRODUCTION

Various studies have demonstrated a low level of asthma control in many countries, including in the Turkish population, as well as the underestimation of disease severity and control by patients and the low level of preventive medicine usage [1-4]. Global Initiative for Asthma (GINA) guidelines suggest the usage of different asthma control tools such as Primary Care Asthma Control Screening Tool, Asthma Control Test (ACT), Asthma Control Questionnaire (ACQ), Asthma Therapy Assessment Questionnaire, and Asthma Control Scoring System, for evaluating asthma control [5]. The use of ACT and ACQ is suggested in the Turkish Asthma Diagnosis and Therapy Guidelines [6]. The Turkish version of ACT is a validated questionnaire [7]. Unfortunately, it was recently demonstrated that the ACT and GINA symptomatic control parameters are only used by 7.6% and 30.4% of the Turkish physicians, respectively [8]. However, these questionnaires include only control parameters and do not include questions on why asthma is not controlled. Comorbidities, treatment irregularity, and wrong inhaler technique are common problems in asthma control as indicated in the 2014 GINA guidelines [5, 9, 10]. In our country, there is no country-based care kit for asthma yet, and the expert groups of the ATA study added some questions to GINA symptomatic control criteria, as they have seen the lack of the questioning their patients by other phy-

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sicians about the comorbidities, treatment adherence, and inhaler techniques.

Generally, physicians in tertiary hospitals have more time for visits than those in secondary and primary care hospitals [11]. They can check for problems in patients with uncontrolled asthma. However, including these patients within the questionnaire itself can facilitate physicians' work. Standard assessment may resolve some of the problems of physicians in our county who typically have a short period of consultation in outpatient clinics [12].

The ATA questionnaire was prepared to determine if patients have their asthma under control by directly asking them about current GINA control criteria and episodes of asthma flare-ups requiring systemic steroid treatment to identify the reasons for uncontrolled asthma to help physicians in asthma management. The validity and reliability of the ATA were investigated by taking expert opinions and establishing its correlation with ACT. This study, through the use of the ATA, also aimed to identify the reasons for the lack of control of asthma and flare-ups requiring systemic corticosteroid treatment in Turkish patients with asthma at tertiary pulmonary diseases clinics.

## MATERIALS AND METHODS

The study was a cross-sectional, national, multicenter observational survey and was conducted between May 15, 2014, and May 15, 2016, in 14 tertiary pulmonary disease clinics with a representative population from 9 different cities comprising 7 different geographic regions of Turkey, which were screened to determine asthma prevalence and regional population ratios. The study protocol was approved by the Istanbul University-Cerrahpasa, Cerrahpasa School of Medicine Ethics Board (No: 83045809/604/02-12334; May 6, 2014). Informed consent was obtained from all participants included in the study.

### Selection of Patients

In the current study, adult patients with asthma were defined as patients diagnosed with asthma by a physician, who were currently taking asthma medication and who had asthma attacks or symptoms during the past 6 months according to GINA guidelines [5]. Patients with asthma (aged >15 years)

reviewed in the outpatient clinics of each center were consecutively enrolled into the study. Patients with coexisting pulmonary diseases, such as pneumonia, bronchiectasis, or emphysema, and those having an asthma attack at the time of enrollment or in the last 4 weeks were excluded.

Recruitment of patients continued in each participating clinic until the required number of patients with asthma, who provided informed consent and underwent a valid interview, was obtained from each area, resulting in a total sample of 810 patients with asthma.

### Questionnaires, Tests, and Interviews

The ACT, used as the gold standard test in the study of symptomatic control of asthma (ATA1), is a five-item tool used to assess asthma symptoms (shortness of breath and night-time symptoms), use of rescue medication, daily functioning, and overall perception of asthma control. The questions on the ACT are scored from 1, indicating the worst control, to 5, indicating the best control, with a maximum best score of 25 [13, 14]. An ACT score of 19 or less provided an optimum balance of sensitivity (71%) and specificity (71%) for detecting uncontrolled asthma [15]. However, an ACT score of >20 predicted GINA-defined, controlled asthma with 51% success rate and kappa statistics of 0.42, representing moderate agreement [15].

The ATA questionnaire is a newly developed test in the Turkish language consisting of 8 items. The first 4 questions evaluate symptomatic control of asthma in terms of the GINA criteria (ATA1). The fifth question asks about the episodes of asthma flare-ups requiring systemic corticosteroid treatment, and the remaining three questions are designed to determine the reasons for uncontrolled disease, including comorbidities like obesity, rhinitis and reflux, irregularity of treatment (adherence), and wrong inhaler technique. Patients' technique was evaluated and feedback was provided after evaluation (1. prepares device correctly for inhalation, 2. breathes out before inhaling medication, 3. inhales medication with acceptable effort, 4. holds breath at least 10s and exhales, and 5. any other error) in the eighth question in the face-to-face interview with their physician. The ATA questionnaire is presented in Appendix 1. The responses of each question are scored 0 or 10, but they represent a binary choice. These scores were chosen to emphasize the difference between the two responses. The best total score is 80 points. With regard to the two sections of the responses for the questions in the ATA, a score of 10 for each question reflects well-controlled asthma or good/right/proper responses. A score of 0 for any of the questions indicates a problem in the corresponding field. The asthma control status of subjects according to ATA 1 scores was defined as follows. Subjects with 40 points, 30-20 points, and 0-10 points were considered as having "controlled asthma," "partly controlled asthma," and "uncontrolled asthma," respectively.

The questions were in Turkish and were translated into English by two native English speakers, and then retranslated into Turkish to check the accuracy.

Information about the demographic parameters and treatment received were also noted by physicians in the medical records of patients.

### MAIN POINTS

- ATA Questionnaire, which evaluates both asthma control and risk factors associated with asthma control with a single instrument, is a validated practical assessment tool for asthma.
- ATA is a physician-administered questionnaire with eight items which assesses 4 symptomatic control criteria of GINA, and queries also the flare-up of asthma, control of comorbidities, treatment adherence, and inhaler technique.
- ATA questionnaire results showed that 34.3% had controlled, 18.8% had partly controlled, and 46.9% had uncontrolled asthma; 16.6% patients had flare-ups between visits, 96.4% patients had uncontrolled comorbidity, 17% patients had irregular asthma treatment, and only 8.4% patients used the incorrect inhaler technique.

### The Visual Analogue Scale (VAS)

A total of 100 patients from Istanbul and Ankara were examined by two pulmonary diseases specialists (professors in pulmonology; BG and DM) with more than 20 years of experience in asthma management. They graded the overall asthma control using VAS, with 10 being very good status and 0 being the worst. Both experts reviewed the patients separately and half of the patients were graded by each expert. Patients received the other questionnaires after this specialist evaluation.

### Statistical Methods and Data Management

Frequencies (n) and percentages (%) were used to describe categorical data such as gender, educational status, smoking status, etc. Descriptive statistics (mean, standard deviation, median, minimum, and maximum) were used for continuous data such as age of patients, ACT scores, etc.

### Validity of ATA Measurements

The construct validity of the ATA measurements was tested through factor analysis and by the difference between groups. Preliminary tests of exploratory factor analysis included Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. Additionally, diagonal terms of anti-image correlation matrix were inspected for sample size adequacy.

Exploratory factor analysis was conducted through principal component analysis (PCA) with Varimax using the Kaiser normalization rotation method.

In our study, we calculated the KMO criterion as 0.795, which shows that the sample size was appropriate for factor analysis.

The Bartlett test evaluates all diagonal terms of the correlation matrix as 1 and all non-diagonal terms as 0. This test also shows that the data of the study follow a multi-normal distribution.

### Reliability Testing for ATA Measurements

Internal consistency of ATA measurements was evaluated by measuring the Cronbach's alpha coefficient. The interclass consistency of ATA measurements was evaluated with the split-half method using Spearman-Brown correlation coefficient. Parallel test reliability between ATA and ACT, scoring of specialists, and GINA control parameters were also tested using the Spearman correlation coefficient (r).

### Determining the ATA Cut-off Value

Receiver Operating Curve (ROC) analysis was used to establish the cut-off values of ATA scores for the evaluation of patients' control status in comparison with ACT. All statistical analyses were performed using IBM Statistical Package for the Social Sciences Version 20.0 (IBM SPSS Corp.; Armonk, NY, USA).

## RESULTS

### Demographic Parameters

A total of 810 patients (78.4% female) were included in the survey. The mean age of the patients was  $44.4 \pm 13.6$  years (range, 16-83 years). The mean duration of asthma was

$10 \pm 9.6$  years. The percentage of patients who have never smoked, who were currently smoking (<10 packs/year), and who had quit smoking (<10 pack/year) were 70.4%, 10.5%, and 19.1%, respectively.

Educational status of the patients was stratified into one of the following six categories: illiterate, literate, elementary, high school, university, and masters/Ph.D. The percentages of patients in these groups were 10.0%, 3.8%, 39.9%, 9.1%, 18.4%, and 18.9%, respectively.

### Questionnaires

The frequency of responses for each question in the ATA (expressed in percentage) is presented in Table 1. The mean ATA1 score, which represents the current GINA control parameters, was  $24.7 \pm 14.8$ , with a median of 30 and maximum of 40. Among the total patients, 34.3% had controlled, 18.8% had partly controlled, and 46.9% had uncontrolled asthma according to the ATA questionnaire. The mean of the total ATA score was  $53.8 \pm 19$ , with a median of 60.

The mean of the ACT score was  $18.8 \pm 5.5$ , with a median of 20. Furthermore, 55.9% of the patients had controlled asthma, and 44.1% of the patients had uncontrolled asthma according to the ACT scores.

The comparison of ACT with ATA1 (GINA symptom control parameters) is presented in Table 2.

The ACT scores of the patients with exacerbation, unstable comorbidity, incorrect inhaler technique, or non-adherence to controller therapy are given in Table 3.

**Table 1.** Frequencies of answers for the ATA questionnaire

Subjects of the Questions	0 point n (%)	10 points n (%)
Day symptoms	262 (32.3)	548 (67.7)
Night symptoms	352 (43.5)	458 (56.5)
Rescue medication	179 (22.1)	630 (77.9)
Daily Activity	444 (54.8)	366 (45.2)
Flare-up	134 (16.6)	671 (83.4)
Comorbidity	553 (69.4)	244 (30.6)
Adherence	137 (17)	668 (83)
Inhaler technique	67 (8.4)	729 (91.6)

ATA: Assessment Tool for Asthma

**Table 2.** Comparison between GINA (ATA1) and ACT

		GINA (ATA1)		
		Uncontrolled	Controlled	Total
ACT	Uncontrolled	342 (66.8)	15 (5.1)	357 (44.1)
	Controlled	170 (33.2)	282 (94.9)	452 (55.9)
	Total	512 (100)	297 (100)	809 (100)

McNemar  $p < 0.001$ . ACT: asthma control test; GINA: global initiative for asthma; ATA1: assessment tool for asthma 1

**Table 3.** ACT scores of the patients with exacerbation, unstable comorbidity, non-adherence to controller therapy and incorrect inhaler technique

Subjects with n (%)	ACT 5-19 n (%)	ACT 20-25 n (%)
Flare-up 134 (16.6)	106 (79.1)	28 (20.9)
Unstable comorbidity 553 (69.4)	186 (33.6)	367 (66.4)
Non-adherence 137 (17)	68 (49.6)	69(50.4)
Incorrect inhaler technique 67 (8.4)	45(67.2)	22 (32.8)

ACT: asthma control test

**Table 4.** Correlation between expert opinion and ATA1, ATA total, and ACT

	Expert opinion		
	n	r	p
ACT	100	0.69	<0.001
ATA1	100	0.936	<0.001
ATA Total	100	0.813	<0.001

ACT: asthma control test; ATA1: assessment tool for asthma 1

**Table 5.** Rotation sums of squared loadings

	% of variance	Cumulative %
1. Component	34.0	34.0
2. Component	16.2	50.2
3. Component	12.9	63.0

1. Component; 1<sup>st</sup> to 5<sup>th</sup> questions for the control data  
 2. Component; 6<sup>th</sup> question for comorbidities  
 3. Component; 7<sup>th</sup>, 8<sup>th</sup> questions for adherence and inhaler technique

The mean VAS score evaluated by the specialists was 7.1±3, with a median of 8 (total range of VAS scores, 0-10). The correlation between the expert opinion and ATA1, ATA total, and ACT is presented in Table 4.

**Reliability of the Questionnaire**

Cronbach’s alpha coefficient (=0.683) was used to evaluate internal consistency.

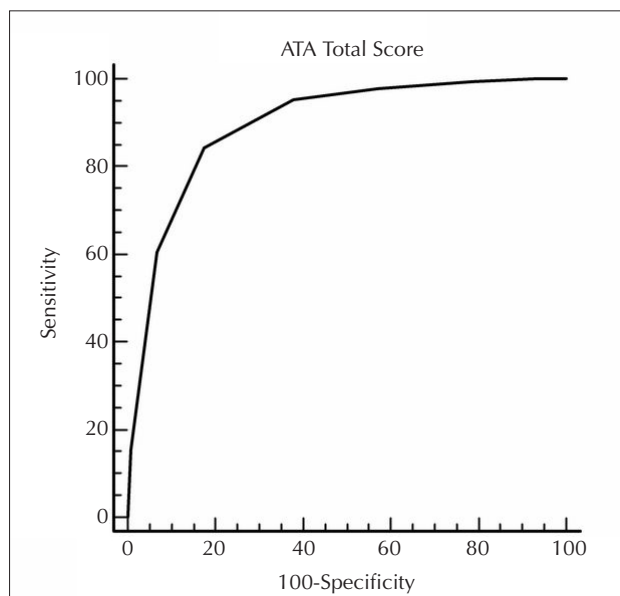
Using the split-half method, the Spearman-Brown correlation coefficient was used to evaluate interclass consistency (the Spearman-Brown coefficient was calculated between the first four and second four questions, r=0.451).

ACT, ATA1, and the specialists’ evaluation using VAS were highly correlated to the total ATA scores. The r- and p-values were as follows: r=0.776, p<0.001; r=0.783, p<0.001; and r=0.909, p<0.001, respectively.

**Validation of the Questionnaire**

**Construct validity/factor analysis**

In our study, the p-value of the Bartlett test was <0.001. The value of Bartlett’s test of sphericity (p<0.001) led to the rejection of the null hypothesis for the independency of the vari-



**Figure 1.** ROC curve for the ATA questionnaire  
 ROC: receiver operating curve; ATA: assessment tool for asthma

ables. Diagonal terms of anti-image correlation matrix varied from 0.464 to 0.854. This interval shows that the sample size was appropriate for factor analysis.

To determine the construction of the components, PCA was used. PCA finds a new set of dimensions (or a set of basis of views) such that all the dimensions are orthogonal (and hence, linearly independent) and ranks them according to the variance of data along them. It means that the more important principle axis occurs first (more important = more variance/more spread out data).

The eigenvalue of the first three components was more than one. In our study, 3 components explained 63% of total variance. The rotation sums of squared loading are presented in Table 5.

According to exploratory factor analysis, the ATA questionnaire consists of three subscales. The first subscale consists of the first five questions (GINA control parameters), the second includes only the sixth question (comorbidity), and the third includes the seventh and eighth questions (adherence and inhaler technique).

**ROC analysis**

ROC analysis was used to determine the cut-off value of ATA scoring for the evaluation of patients’ control status. Classification variables were set as ACT total scores (≥20 controlled asthma, ≤19 uncontrolled asthma).

The area under the ROC curve (AUC) was 0.896 with a standard error of 0.0114; the 95% confidence interval (Binomial exact) was 0.872 to 0.916 and the z statistic was 34.784. The significance level (area=0.5) was p<0.0001. Youden index J value was 0.6681, and the associated criterion was >50. Criterion values and coordinates of the ROC curve are demonstrated in Table 6. According to ROC analysis, the cut-off value was calculated as 50 (sensitivity=84.4%, specificity=82.40%) (Figure 1).



**Table 6.** Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	95% CI	-LR	95% CI
≥0	100.00	99.2–100.0	0.00	0.0–1.1	1.00	1.0–1.0		
>0	100.00	99.2–100.0	1.17	0.3–3.0	1.01	1.0–1.0	0.00	
>10	100.00	99.2–100.0	6.45	4.1–9.6	1.07	1.0–1.1	0.00	
>20	99.54	98.4–99.9	21.41	17.2–26.1	1.27	1.2–1.3	0.021	0.005–0.09
>30	97.94	96.1–99.1	42.82	37.5–48.3	1.71	1.6–1.9	0.048	0.02–0.09
>40	95.41	93.0–97.2	62.17	56.8–67.3	2.52	2.2–2.9	0.074	0.05–0.1
>50	84.40	80.7–87.7	82.40	77.9–86.3	4.80	3.8 - 6.1	0.19	0.2–0.2
>60	60.55	55.8–65.2	93.26	90.1–95.7	8.98	6.0 - 13.4	0.42	0.4–0.5
>70	15.37	12.1–19.1	99.12	97.5–99.8	17.47	5.5 - 55.1	0.85	0.8–0.9
>80	0.00	0.0–0.8	100.00	98.9–100.0			1.00	1.0–1.0

ROC: receiver operating curve; CI: confidence interval; LR: likelihood ratio

## DISCUSSION

This ATA study demonstrated the validity and reliability of the ATA questionnaire (8 questions with 2 items) and revealed that of the total patients examined, 46.9% patients had uncontrolled asthma, 16.6% patients had flare-ups between visits, 69.4% patients had uncontrolled comorbidity, 17% patients had irregular asthma treatment, and only 8.4% patients used the incorrect inhaler technique. A standard assessment may solve the problems of physicians. Assessment of symptomatic control parameters is insufficient. A patient who has controlled scores with ACT for the last 4 weeks may have exacerbation since her/his last visit or unstable comorbidity or incorrect inhaler technique or non-adherence to controller therapy, all of which can be a risk factor for future exacerbations [5]. A physician who does not ask these questions can continue the same therapy and do not think to correct them. This can incur high cost or lead to the usage of high levels of inhaled steroids or misuse of long acting beta 2-agonists if ACT controlled scores are with non-adherence or incorrect inhaler usage. In our study, there were 137 (17%) non-adherent patients, but 69 (50.4%) of them had ACT scores of 20-25 (controlled). There were 67 (8.4) patients with incorrect inhaler technique, but 22 (32.4%) had controlled ACT scores. The ATA questionnaire is more than the control questionnaires and it can be easily used by physicians as an assessment tool for patients with asthma in outpatient clinics. There are validated questionnaires for symptomatic control, questioning the comorbidity, treatment adherence, inhaler technique, but inquiring about all these aspects take time, and in our country, physicians have limited time for each patient [12].

### Patient Demographics

The questionnaire was applied to 810 patients with asthma from different regions of the country by physicians of adult pulmonology departments in tertiary outpatient clinics. There was a large variation in age (16 to 83 years) and educational status of the patients for determining the understandability of the questions. As a real life study, patients with all types of asthma as defined by the 2014 GINA parameters were included (smokers, obese, allergic, and elderly).

### ATA Questionnaire

The present study examined the validity and reliability of ATA in the samples from a Turkish population of outpatients with asthma. Exploratory factor analysis revealed a three-factor model. The reliability of the study was shown by Cronbach's alpha coefficient (0.683). Parallel test reliability was assessed by comparison of ATA with ACT and evaluation by specialists using VAS. The correlation was high for all these tests. According to ROC analysis, the cut-off value was calculated as 50 (sensitivity=84.4%, specificity=82.4%) for patients with asthma. However, this cut-off value should be investigated by further research.

### Asthma Control

The ACT, validated in Turkish, was used in studies on Turkish population and administered by pulmonary disease specialists in Turkey to demonstrate inadequate control of asthma [3, 7]. In a study by Turktas et al. [3], 51.5% patients were determined to have controlled asthma using ACT. In a study by Uysal et al. [7], 64.2% patients had controlled or partly controlled asthma as indicated by GINA criteria. In our study, 55.9% patients had controlled asthma according to ACT and 53.1% patients had controlled or partly controlled asthma according to GINA or ATA1 criteria. In the LIAISON study of 8111 patients with asthma enrolled in 12 European countries, 56.5% patients demonstrated asthma control [16]. Our findings of ATA1 represent the current symptomatic control of GINA parameters. The discordance between ACT and ATA 1 seen in the Table 2 must be re-evaluated in other studies. In contrast, 170 patients with uncontrolled asthma on ATA1 showed controlled scores with ACT. In our country, patients underestimate their disease severity and overestimate their level of disease control [1]. The patients believed that their asthma was controlled and gave 4 or 5 points for the fifth question of ACT. This question is not present in ATA 1, which demonstrated direct GINA 1 criteria. Erkokoglu et al. [17] demonstrated that the consistency between GINA and pediatric ACT is not as expected. Although ATA1 has demonstrated good correlation with ACT and the VAS evaluation by experts, high level of uncontrolled disease in ATA1 is a remarkable finding for tertiary pulmonary disease clinics in Turkey. The moderate correlation between ACT and expert

opinion seen in the study, and the good correlation of expert opinion with ATA1 and ATA total may be explained with the difference that the experts ask usually for GINA symptom control criteria and for some other questionnaires like ATA1 and ATA total, but patients directly respond to the questions in ACT. The VAS is the simplest test when it was used by asthma experts but we did not recommend this for all physicians.

### Exacerbations of Asthma

Previous studies have shown that a history of both past asthma exacerbations and poor asthma control could increase the risk of future asthma exacerbations [16, 18, 19]. Patients usually go to their primary care physician for their flare-ups and tertiary pulmonary diseases clinics. Physicians will be able to identify a history of exacerbation and oral steroid use during their appointments by the usage of ATA questionnaire. We think that having asthma exacerbation questions in the assessment list is important for determining the future risk of asthma, as 16.6% of the patients had flare-up between visits in this study, as assessed by the ATA questionnaire. Physicians can take precautions for another exacerbation if they understand the previous causes of exacerbations.

### Comorbidities

Comorbidities may contribute to poor asthma control as indicated by GINA guideline [5, 20]. The role of comorbidities in the economic burden of asthma was demonstrated recently in a study by Chen et al. [21]. Given therapies or taking care of comorbidities such as allergic rhinitis, symptomatic gastroesophageal reflux disease, obesity, and psychiatric disorders increases asthma control [5, 22-24]. High rhinosinusitis, gastroesophageal reflux, and obesity rates have been demonstrated in other Turkish studies on patients with asthma [25, 26]. Another important issue is that the presence of gastroesophageal reflux may have a negative impact on the adherence to treatment in elderly patients, as demonstrated in a study by Gemicioglu et al. [25]. In our study of the sixth question in the ATA, 69.4% patients had uncontrolled comorbidities. We think that asking the sixth question can influence the physician as well as patients to contribute in the management of the comorbidity.

### Adherence to Treatment

Poor adherence to treatment and incorrect inhaler technique were described in GINA as the risk factors for exacerbation of asthma [5]. These may be the most important factors for poor asthma control, representing 60% of the reasons expressed by physicians and 42.7% of those expressed by patients in the LIAISON study [15]. In our study, 17% patients reported non-adherence to asthma treatment. This finding is concordant with another study from Turkey [24]. However, we believe that asking this seventh question of ATA and regularly using controller therapy provides the chance to understand the patients' adherence to the treatment. The physician can discuss the reasons for non-adherence to the treatment with the patient to correct any possible misunderstanding regarding asthma therapy [27].

### Inhaler Technique

Physicians should be able to demonstrate and validate that patients follow the correct inhaler technique for each of the

inhalers they prescribe. However, having the eighth question of ATA in their assessment tool might serve as a useful reminder. In addition to the high regular treatment adherence rate in our study, only 8.4% patients used incorrect inhaler technique. Many authors recommended that inhaler technique evaluation and measurement of patient compliance for the prescribed treatments should be considered for inclusion in the current assessment tools [10, 28, 29].

### Study Limitations

The ATA questionnaire is in Turkish and its application in only tertiary pulmonary disease clinics may be a major limitation of the study. However, we would first like to demonstrate the validation of this assessment tool in pulmonary disease clinics. The ATA questionnaire, similar to the ACQ, is only an assessment tool and does not include a pulmonary function. If required, the physician needs to do perform tests for pulmonary function. Many other questionnaires may be asked by the physicians for the inhaler technique, the adherence and for every comorbidity, but we were interested in a quick assessment of asthma control in terms of symptom control parameters and risk factors for uncontrolled asthma according to GINA guideline.

In conclusion, the ATA questionnaire, which has excellent sensitivity and specificity, may be a practical tool for physicians in asthma management as it includes the current GINA control parameters (ATA1), questions on flare-up periods, and reasons for the lack of asthma control such as comorbidities, adherence to treatment, and inhaler technique. There are multiple questionnaires for every problem experienced during asthma management, but as explained by Musellim B et al's study, physicians have extremely short time for patient visits in our country (12). We hope that this assessment tool might be concordant with the current GINA guidelines and its use may ameliorate some problems in asthma management.

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## Supplementary Material

### Appendix 1: Assessment Tools for Asthma (ATA) Questionnaire

1. In the past 4 weeks, how often did you have daytime asthma symptoms in a week (dyspnea, cough, wheezing, chest tightness)?

- Never or less than twice a week (10)
- More than twice a week (0)

2. In the past 4 weeks, how often did your asthma symptoms (dyspnea, cough, wheezing, chest tightness awakening) wake you up at night or earlier than usual in the morning?

- Never (10)
- One night or more (0)

3. In the past 4 weeks, how often have you used your rescue bronchodilator medication (relieving symptoms of asthma) in addition to your regular daily treatment?

- Never or less than twice a week (10)
- 3 or more days or every day (0)

4. In the past 4 weeks, how many times have you experienced any limitation in your daily activities (work, school, exercise, and house work, etc.) due to asthma symptoms?

- Never (10)
- 1 or more days (0)

5. Did you have any unplanned office/emergency room visits since your last visit because of asthma flare-up and required systemic corticosteroid usage?

- No (10)
- Yes (0)

6. Do you have any accompanying uncontrolled diseases such as allergic/non-allergic rhinitis, sinusitis, reflux (heartburn, gastric symptoms), obesity, or others?

- No (10)
- Yes (0)

7. Have you used your controller inhaler regularly since your last visit (especially in the past week)?

- Yes (10)
- No (0)

8. Would you please show me the way you use your inhaler device(s)?

- Technique is correct (10)
- Technique is incorrect (0)

ATA 1 score:

ATA 2 score:

Total score:

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