Original Article

Access this article online
Quick Response Code:

Website:
https://eurasianjpulmonol.org
DOI:
10.14744/ejp.2026.15456

Turkish validation of the "Test of Adherence to Inhalers Questionnaire" in patients with asthma and chronic obstructive pulmonary disease

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Abstract:

BACKGROUND AND AIM: This study aimed to evaluate the validity, reliability, and diagnostic accuracy of the Turkish version of the Test of Adherence to Inhalers (TAI), a widely used tool for assessing inhaler adherence in patients with asthma and chronic obstructive pulmonary disease (COPD).

METHODS: This cross-sectional study included 100 patients with asthma (n=50) or COPD (n=50) who were followed in outpatient clinics between February and May 2024. Adherence was assessed using the TAI-10 and TAI-12 questionnaires and the Morisky Medication Adherence Scale-8 (MMAS-8). Internal consistency was evaluated using Cronbach's alpha coefficients. Construct validity was examined using Spearman correlation analysis, and diagnostic accuracy was assessed using receiver operating characteristic (ROC) curve analysis.

RESULTS: The mean age was significantly higher in the COPD group than in the asthma group (70.9±8.3 vs. 48.0±17.3 years, p<0.001). The groups differed significantly in gender distribution, comorbidities, smoking status, symptom burden, and exacerbation history (all p<0.05). TAI and MMAS-8 did not differ significantly between asthma and COPD patients. The Turkish TAI demonstrated good internal consistency (Cronbach's α=0.836 for TAI-10 and 0.826 for TAI-12) and strong correlations with MMAS-8 scores (r=0.917 and r=0.902; p<0.001). Both versions showed high diagnostic accuracy for identifying non-adherence (area under the curve=0.892 and 0.876), with optimal cut-off values of ≤45 for TAI-10 and ≤47 for TAI-12, respectively.

CONCLUSIONS: The Turkish versions of TAI-10 and TAI-12 are valid and reliable instruments with high diagnostic accuracy for assessing inhaler adherence in patients with asthma and COPD.

Keywords: Asthma, chronic obstructive pulmonary disease, Test of Adherence to Inhalers, Turkish validation

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Received: 06-01-2026
Revised: 09-02-2026
Accepted: 12-02-2026
Published: 20-05-2026

How to cite this article: Yüksel Yavuz M, Turan MO, Güneş S, Öztürksoy ÇC, Sözmen MK, Mahleç C, Sertoğullarından B. Turkish validation of the "Test of Adherence to Inhalers Questionnaire" in patients with asthma and chronic obstructive pulmonary disease. Eurasian J Pulmonol 0000;00:1-8.

Introduction

Medication nonadherence is a major barrier to the effective management of chronic diseases. The World Health Organization has highlighted poor adherence as a serious global health problem affecting approximately half of patients with chronic illnesses. In chronic respiratory conditions such as asthma and chronic obstructive pulmonary disease (COPD), suboptimal adherence to inhaled therapies is associated with more frequent exacerbations, worse disease control, higher hospitalization rates, and even increased mortality.[1,2] Studies indicate that up to 50% of patients with asthma or COPD do not use their inhalers as prescribed due to factors such as poor inhaler technique, complex treatment regimens, cognitive impairment, as well as low health literacy.[3,4] Moreover, patients' beliefs about medications, perceptions of their disease, and the lack of perceived immediate benefit from inhaled therapy may further reduce adherence. Recognizing and addressing these multifactorial determinants of nonadherence is essential to enhance therapeutic success and reduce the healthcare burden associated with poorly controlled chronic airway diseases.[5] Clinical practice guidelines for asthma and COPD accordingly emphasize the need to assess and improve adherence at every opportunity.[6,7] However, simply asking patients whether they use their inhalers often leads to overestimation of adherence; therefore, more reliable assessment methods are necessary. Several self-report questionnaires are available to assess medication adherence. Although the Morisky Medication Adherence Scale (MMAS-8) is the most widely used, other tools have also been developed, including questionnaires specific to inhaler therapy, such as the Medication Adherence Report Scale for Asthma (MARS-A), the Adherence to Asthma Medication Questionnaire (AAMQ).[8–12] The Turkish version of the MMAS-8, previously validated by Oğuzülgen et al.,[13] is a reliable tool for assessing medication adherence in patients with asthma and chronic obstructive pulmonary disease. Until the development of the TAI in 2016, there was no instrument specifically tailored to the unique challenges of inhaler therapy, such as device technique and routine use, which may differ from oral medication regimens. To address this gap, a Spanish research group developed the Test of Adherence to Inhalers (TAI) questionnaire. The TAI is a self-reported adherence tool created specifically for patients with asthma and COPD. This questionnaire has been used to assess inhaler adherence among patients with asthma and chronic obstructive pulmonary disease in both clinical practice and research settings. It provides a structured approach to evaluating adherence related to inhaler use. However, despite its applicability, a validated Turkish version of the scale is not yet available. The original validation study of the TAI in Spain, conducted in more than 900 patients, demonstrated that the TAI is a reliable and homogeneous questionnaire for identifying nonadherence and differentiating behavioral patterns of nonadherence. The TAI showed good internal consistency (Cronbach's α ~0.87) and test–retest reliability (intraclass correlation coefficient [ICC] ~0.88) in the original cohort, and it moderately correlated with objective electronic inhaler usage monitoring data. Notably, that study found that patients with COPD were more likely to exhibit good adherence than patients with asthma (49% vs. 28% prevalence of good adherence) and tended to have more "unconscious" (unintentional) nonadherence, whereas patients with asthma more often showed erratic or deliberate nonadherence.[14,15] Given the proven utility of the TAI in international settings, a validated Turkish version could greatly assist clinicians in Türkiye in evaluating inhaler adherence and identifying barriers in their patients. Therefore, we aimed to translate the TAI questionnaire into Turkish and evaluate its validity and reliability in a sample of patients with asthma and COPD.

Materials and Methods

Ethical approval

The study was approved by the İzmir Katip Çelebi University Non-interventional Clinical Research Ethics Committee (Approval Number: 0111-0112, Date: 21.03.2024). The study was conducted in accordance with the Ethical Principles for Medical Research Involving Human Subjects outlined in the Declaration of Helsinki (2013 revision) and the Declaration of Istanbul (2018). Written informed consent was obtained from all participants. Permission to use the original version of the TAI was obtained via e-mail from the original author.

Study design and patients

This cross-sectional validation study was conducted in a tertiary pulmonology clinic in Izmir. Patients diagnosed with asthma or COPD who were receiving inhaled maintenance therapy were recruited from outpatient clinics between February and May 2024.

Sample size estimation was performed using OpenEpi (v3.01) with a 95% confidence level and 80% power, resulting in a required sample size of 50 subjects per group (asthma and COPD). Accordingly, we aimed to enroll a total of 100 patients, including both asthma and COPD cases, to ensure an adequate sample size for statistical analyses.

The inclusion criteria were age ≥18 years, a confirmed physician diagnosis of asthma or COPD according to standard guidelines, and current use of at least one inhaler medication for ≥3 months. Patients with cognitive impairment or any language barrier preventing completion of the questionnaire were excluded.

Data collection

After providing informed consent, each participant completed a questionnaire package under supervision. This included: (1) the 10-item TAI (self-administered by the patient) and the additional 2-item TAI section (completed by the clinician) in their Turkish-translated form; (2) the 8-item MMAS-8, a validated self-report measure of general medication adherence; and (3) a demographic and clinical questionnaire capturing age, sex, smoking history, comorbid conditions, disease duration, current respiratory symptoms, history of recent exacerbations, and the types of inhaler devices used. Patients were instructed on how to answer the TAI and Morisky questionnaires and were informed that the data would be used solely for research purposes to encourage honest responses. A researcher was available to clarify any questions during survey completion. Because the study had a cross-sectional design, the test–retest reliability was not assessed. The TAI consists of a 10-item patient questionnaire and an optional 2-item clinician questionnaire. Each of the 10 patient items is scored from 1 (poor adherence) to 5 (good adherence), yielding a total score ranging from 10 to 50. This total score allows classification of the patient's adherence level as good (50 points), intermediate (46–49), or poor (≤45). The two additional clinician-rated items (each scored 1 or 2) assess the patient's knowledge of the inhaler regimen and inhalation technique. These items help identify the pattern of nonadherence—whether it is sporadic (erratic timing of doses), deliberate (intentional omission), or unconscious (unwitting improper use).

Data analysis and statistical methods

Translation of TAI

The TAI questionnaire was translated and culturally adapted into Turkish following internationally accepted guidelines for cross-cultural scale validation. First, two independent bilingual translators (fluent in English and Turkish) translated the original English version of the TAI (derived from the Spanish version) into Turkish. Discrepancies between the two translations were resolved by consensus, resulting in an initial Turkish version. Next, this version was back-translated into English by a different bilingual translator who was not involved in the first step, to verify fidelity to the original meaning. An expert committee including pulmonologists reviewed the translations to ensure that the Turkish wording was clear, conceptually equivalent to the original, and culturally appropriate. A small pilot test was then conducted in which the draft Turkish TAI was administered to five patients with asthma or COPD to evaluate the clarity and interpretability of the items. Based on patient feedback, minor wording refinements were made to improve clarity. The final Turkish version of the TAI was thus obtained without altering the core content of the original items. The final version is presented in Table 1.

Reliability and validity analysis

We evaluated the internal consistency reliability of the Turkish TAI using Cronbach's alpha coefficient for the 10-item patient domain (TAI-10) and for all 12 items (TAI-12). An alpha value ≥0.7 was considered acceptable, with ≥0.8 indicated good internal consistency. Test–retest reliability was not formally assessed in this study due to the cross-sectional design; therefore, patients completed the TAI only once, and all items were required to be answered. To assess concurrent validity, we examined the correlation between TAI scores and Morisky scale scores, as the Morisky scale is an established measure of adherence behavior. Because the TAI score (10–50) and the Morisky MMAS-8 score (0–8) are ordinal, Spearman's rank correlation coefficient (rho) was used to evaluate their association. Correlation strength was interpreted as follows: rho ≥0.7, strong; 0.4–0.69, moderate; and <0.4, weak correlation. Additionally, adherence scores were compared across groups to evaluate known-groups validity. We hypothesized that adherence might differ between patients with asthma and those with COPD, as well as according to other clinical characteristics. Mean TAI and Morisky scores were compared between disease groups (asthma vs. COPD) using the Student's t test for normally distributed variables or the Mann–Whitney U for non-normally distributed variables. Differences in adherence scores were also examined according to sex, presence of comorbidities, current smoking status, presence of uncontrolled symptoms at the time

Table 1: Turkish version of the Test of Adherence to Inhalers (TAI) questionnaire

No	Question in English	Translation (Turkish)	Scoring
Patient domain			
1	During the last 7 days, how many times did you forget to take your usual inhalers?	Son 7 gün içinde, inhalerinizi almayı kaç kez unuttunuz? Her zaman (1) – Yarısından fazla (2) – Yaklaşık yarısı kadar (3) – Yarısından az (4) – Hiç (5)	1–5
2	Do you ever forget to take your inhalers?	İnhalerinizi almayı unuttuğunuz olur mu? Her zaman (1) – Çoğunlukla (2) – Bazen (3) – Nadiren (4) – Asla (5)	1–5
3	When you feel well, do you stop taking your inhalers?	Kendinizi iyi hissettiğinizde inhaler kullanmayı bırakır mısınız? Her zaman (1) – Çoğunlukla (2) – Bazen (3) – Nadiren (4) – Asla (5)	1–5
4	When you are on vacation or during the weekend, do you stop taking your inhalers?	Tatilde veya hafta sonu olduğunda inhaler kullanmayı bırakır mısınız? Her zaman (1) – Çoğunlukla (2) – Bazen (3) – Nadiren (4) – Asla (5)	1–5
5	When you feel nervous or sad, do you stop taking your inhalers?	Sinirli veya üzgün olduğunuzda inhaler kullanmayı bırakır mısınız? Her zaman (1) – Çoğunlukla (2) – Bazen (3) – Nadiren (4) – Asla (5)	1–5
6	Do you stop taking your inhalers because you are afraid of side effects?	Yan etkilerinden korktuğunuz için inhaler kullanmayı bırakır mısınız? Her zaman (1) – Çoğunlukla (2) – Bazen (3) – Nadiren (4) – Asla (5)	1–5
7	Do you stop taking your inhalers because you think they are ineffective?	İnhalerlerin hastalığınızı tedavi etmekte faydasız olduğunu düşündüğünüz için kullanmayı bırakır mısınız? Her zaman (1) – Çoğunlukla (2) – Bazen (3) – Nadiren (4) – Asla (5)	1–5
8	Do you take fewer inhalations than those prescribed by your doctor?	Doktorunuzun önerdiğinden daha az inhalasyon yaptığınız olur mu? Her zaman (1) – Çoğunlukla (2) – Bazen (3) – Nadiren (4) – Asla (5)	1–5
9	Do you stop taking your inhalers because you believe they interfere with your daily or working life?	İnhalerlerin günlük yaşamınızı veya işinizi etkilediğini düşündüğünüz için kullanmayı bırakır mısınız? Her zaman (1) – Çoğunlukla (2) – Bazen (3) – Nadiren (4) – Asla (5)	1–5
10	Do you stop taking your inhalers because you have difficulty paying for them?	Maddi nedenlerle inhalerlerinizi almakta zorlandığınız için kullanmayı bırakır mısınız? Her zaman (1) – Çoğunlukla (2) – Bazen (3) – Nadiren (4) – Asla (5)	1–5
Sağlık Profesyoneli Alanı (Healthcare Professional Domain)			
11	Does the patient remember the prescribed regimen (dose and frequency)?	Hasta, kendisine reçete edilen dozu ve kullanım sıklığını hatırlıyor mu? Hayır (1) – Evet (2)	1–2
12	Is the patient's inhaler technique correct? (assessment of inhalation technique)	Hastanın inhaler cihazını kullanma tekniği nasıldır? Kritik hatalarla (1) – Kritik hata olmadan (2)	1–2

of the visit, disease duration (dichotomized by the median), history of ≥1 exacerbation in the previous year, and type of inhaler device (e.g., dry powder inhaler vs. metered-dose inhaler). Categorical variables (e.g., sex differences between asthma and COPD groups or the proportion of adherent vs. nonadherent patients) were analyzed using the chi-square test or Fisher's exact test when expected cell counts were small. A two-tailed p-value <0.05 was considered statistically significant. Statistical analyses were performed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA).

Results

Patient characteristics

A total of 100 patients were enrolled, including 50 patients with asthma and 50 with COPD. The mean age of patients with asthma was 48.0±17.3 years, whereas the mean age of patients with COPD was 70.9±8.3 years (p<0.001). Overall, 48% of the study population were male. Among all participants, 68% had at least one comorbidity. Regarding smoking status, 35% were current smokers, 37% were former smokers, and 28% were never smokers. In terms of inhaler device use, 71% of patients were using dry powder inhalers and 29% were using metered-dose inhalers. Significant differences between asthma and COPD patients were observed in terms of sex distribution (p<0.001), presence of comorbidities (p=0.010), smoking status (p<0.001), presence of symptoms (p=0.022), and history of exacerbations (p<0.001).

Adherence scores and group comparisons

No significant difference was observed between the asthma and COPD groups in terms of TAI and Morisky scale scores (p=0.252 and p=0.442, respectively). Similarly, no statistically significant differences in adherence (according to both scales) were found according to sex, presence of comorbidities, smoking status, presence of symptoms, disease duration, history of exacerbations, or type of inhaler device (Table 2).

Table 2: Comparison of TAI and MMAS-8 scores between patients with asthma and chronic obstructive pulmonary disease (COPD)

Parameter	Asthma (n=50)	COPD (n=50)	p
TAI-10 total score (mean±SD)	45.6±6.8	44.2±7.1	0.252
TAI-12 total score (mean±SD)	54.7±8.2	53.1±8.4	0.262
MMAS-8 total score (mean±SD)	6.5±1.2	6.3±1.4	0.442
Adherence level (according to TAI or MMAS-8), n (%)			
High adherence	41 (41%)	39 (39%)	0.731
Moderate adherence	37 (37%)	36 (36%)	0.864
Low adherence	22 (22%)	25 (25%)	0.590

TAI-10: Test of Adherence to Inhalers (10-item version), TAI-12: Test of Adherence to Inhalers (12-item version), SD: Standard deviation, MMAS-8: Morisky Medication Adherence Scale (8-item version)

Reliability of the Turkish TAI

The internal consistency reliability of the Turkish version of the TAI was satisfactory. Cronbach's alpha coefficient was 0.836 for the 10-item patient domain (TAI-10) and 0.826 for the full 12-item version (TAI-12), indicating good internal consistency for both versions of the scale. All items were required to be answered, and no missing responses were observed.

Validity of the Turkish TAI

In this study, only the linguistic validity of the TAI questionnaire was assessed. The original English version was translated into Turkish and then back-translated by two bilingual translators. The translated version was reviewed by two pulmonologists and a linguist to ensure clarity, conceptual equivalence, and cultural appropriateness. Only linguistic validation was performed in this study; no additional statistical analyses of construct or criterion validity were conducted.

In our study, a strong positive correlation was observed between the TAI-10 and TAI-12 scores and the Morisky score (r=0.917 and r=0.902, respectively; p<0.001) [Fig. 1]. The reliability coefficients of the TAI-10 and TAI-12 scales were Cronbach's α=0.836 and α=0.826, respectively. In the receiver operating characteristic (ROC) analysis, both TAI-10 and TAI-12 demonstrated excellent discrimination in identifying nonadherent patients, with area under the curve (AUC) values of 0.892 (95% confidence interval [CI]: 0.83–0.95; p<0.001) and 0.876 (95% CI: 0.80–0.94; p<0.001), respectively. The optimal cut-off values determined using the Youden index were ≤45 for TAI-10 and ≤47 for TAI-12, yielding sensitivities of 84% and 82%, and specificities of 86% and 84%, respectively [Fig. 2].

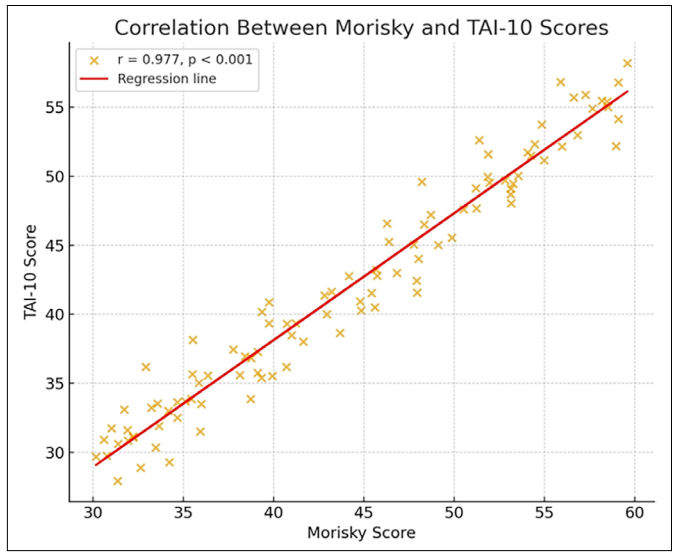

Figure 1: Correlation between the Morisky Medication Adherence Scale (MMAS) score and the Test of Adherence to Inhalers (TAI) scores

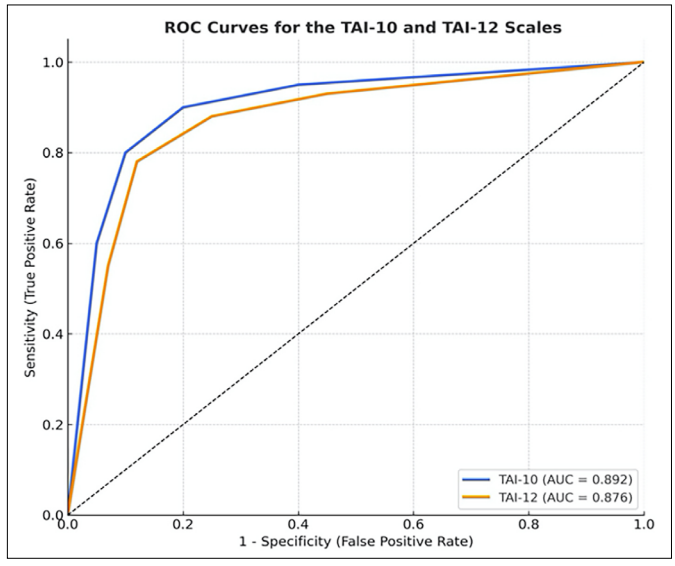

Figure 2: Receiver operating characteristic (ROC) curves illustrating the diagnostic performance of the Test of Adherence to Inhalers-10 (TAI-10) and the Test of Adherence to Inhalers-12 (TAI-12) scales in identifying nonadherent patients

Discussion

In this study, the Turkish version of the Test of Adherence to Inhalers demonstrated good reliability, strong validity, and high diagnostic performance in assessing inhaler adherence among patients with asthma and chronic obstructive pulmonary disease. One of the key findings was the high internal consistency reliability of the Turkish version of the Test of Adherence to Inhalers, with Cronbach's α=0.836 for the 10-item TAI and 0.826 for the full 12-item scale. This level of reliability indicates good ho-

mogeneity of the items and is comparable to that reported in the original Spanish validation (Cronbach's α≈0.86).[14] Similarly, other language versions of the TAI have reported α values in the range of 0.82–0.87, confirming that the questionnaire consistently maintains good reliability across diverse populations.[16] Another important result of our study was the very strong positive correlation between TAI scores and the 8-item Morisky Medication Adherence Scale (r=0.917 for TAI-10 and r=0.902 for TAI-12), supporting the convergent validity of the TAI as a measure of inhaler adherence. This correlation is notably higher than those observed in some previous validation studies using different reference standards. For instance, the original Spanish study found only a weak correlation with electronic inhaler monitoring (ρ≈0.29), and an Iranian (Persian) version reported a moderate correlation with a general medication adherence scale (r≈0.61).[14,16] The stronger association observed in our study may reflect the use of another self-report instrument (MMAS-8) as the comparator, indicating that the TAI captures adherence behaviors in line with existing patient-reported measures while also providing inhaler-specific insights that general scales such as the MMAS-8 may overlook. The TAI also demonstrated excellent diagnostic accuracy in identifying nonadherent patients in our sample. The area under the receiver operating characteristic curve was 0.892 for the 10-item TAI and 0.876 for the 12-item TAI, indicating a favorable balance between sensitivity and specificity for detecting adherence problems. In practical terms, these AUC values approach the "excellent" range for diagnostic tools and suggest that the Turkish TAI can reliably distinguish adherent from nonadherent inhaler users. Notably, our AUC values were higher than those reported in the original Spanish validation study, which found an AUC of approximately 0.70 when electronic dose counter data were used as the reference criterion.[14] This discrepancy could be due to differences in the gold standard definition of adherence. Our use of the MMAS-8 (a self-report classification) may have led to greater concordance with the TAI, whereas the Spanish study's objective electronic monitoring likely represented a more stringent benchmark. Nonetheless, the high AUC observed in our study underscores the value of the TAI as a screening tool for nonadherence. We also observed that the TAI can classify the nature of a patient's nonadherence, consistent with the design of the instrument. The original developers of the TAI described three patterns of inhaler nonadherence—erratic (inconsistent forgetfulness), deliberate (intentional nonuse), and unwitting (incorrect technique or lack of understanding)—based on two additional clinician-completed items. Our Turkish translation retains these items, enabling clinicians not only to measure adherence levels but also to identify the predominant type of nonadherence. This has direct implications for tailored interventions, such as educational support for "unwitting" nonadherers or behavioral reminders for "erratic" nonadherers.

Importantly, we found no significant differences in TAI-measured adherence scores across various patient subgroups. Adherence levels were similar between patients with asthma and those with COPD, with neither disease group demonstrating higher TAI scores. This finding is consistent with the intended use of the instrument in both asthma and COPD populations. The TAI was originally developed and validated in a combined asthma/COPD cohort, and our results confirm that it performs similarly regardless of diagnosis. We also did not observe any significant effect of gender on adherence in our sample, as men and women had comparable TAI scores. Likewise, patients with comorbid chronic conditions had adherence scores similar to those without comorbidities, and the presence of respiratory symptoms (as reflected by dyspnea severity or level of asthma control) did not significantly influence TAI results. Notably, neither smoking status nor the type of inhaler device used (e.g., dry powder inhaler vs. metered-dose inhaler) was associated with differences in adherence according to the TAI. Overall, these findings suggest that poor adherence is a widespread challenge that cuts across demographic and clinical categories. This observation is consistent with previous studies indicating that nonadherence to inhaled therapy is widespread and not limited to specific subgroups. For example, a recent validation study in COPD patients reported no relationship between TAI-defined adherence and the number of comorbidities or baseline symptom scores.[17] The lack of subgroup differences in our study reinforces the notion that all patients with asthma or COPD, regardless of their clinical profile, should be considered for adherence assessment. Good or poor inhaler use cannot be reliably predicted solely on factors such as sex, symptom burden, or disease type. Our results are broadly consistent with previous validation studies of the TAI conducted in other languages and populations, which further supports the credibility of the Turkish TAI. Since its introduction in Spain, the TAI has undergone cross-cultural adaptation in numerous

countries and is now available in more than 20 languages, including Spanish, Portuguese (European and Brazilian), several Arabic dialects (e.g., Saudi Arabian and Egyptian Arabic), Chinese, Persian, and others.[18] A Malaysian study conducted in patients with asthma reported Cronbach's α=0.871 and test–retest ICC=0.832, values very close to those observed in our study. That study also demonstrated high sensitivity (>85%) and specificity of the TAI when benchmarked against pharmacy refill data.[19] The Persian version of the TAI, validated in patients with COPD, reported extremely high internal consistency (α=0.986) together with an excellent test–retest reproducibility. However, its concurrent validity with a general medication adherence scale was only moderate, possibly due to the use of a different comparator or the smaller sample size in that study.[16] Despite minor differences across studies, these validation efforts conducted in Europe, Asia, or the Middle East support the TAI as a reliable self-report tool for assessing inhaler adherence. Collectively, the literature indicates that patients from diverse cultural contexts can understand and respond to the TAI in a similar manner, making it a broadly applicable instrument for evaluating inhaler adherence. It is also noteworthy that none of these studies identified fundamental limitations in the questionnaire's utility. On the contrary, many authors recommend the TAI as a preferred tool for assessing inhaler adherence in clinical practice. The widespread adoption of the TAI across multiple languages, including the Turkish version evaluated in our study, further highlights its practicality and clinical relevance.

This study has several limitations. First, due to its cross-sectional design, we were unable to assess causality or the temporal stability of TAI scores. Test–retest reliability was not evaluated; therefore, measurement consistency over time remains unknown. Although we found a strong correlation with the MMAS-8, no objective adherence measure (e.g., electronic monitoring or pharmacy data) was used, which may introduce self-report bias. Construct validity was not analyzed, and TAI scores were not correlated with clinical outcomes such as symptom control or exacerbation history. Additionally, our sample included only patients with asthma and COPD, which limits the generalizability of the findings to other respiratory conditions. Finally, as this is the first validation study of the TAI in Turkish, no prior local reference standard exists beyond the MMAS-8, and subtle cultural factors may influence the interpretation of some items.

Future studies should evaluate the test–retest reliability of the Turkish TAI, examine its relationship with clinical outcomes, and assess its validity against objective adherence measures. Studies with larger sample sizes and interventional designs may further clarify its structure and clinical utility.

Conclusion

In conclusion, the Turkish version of the TAI is a valid and reliable tool for assessing inhaler adherence in patients with asthma and COPD. It enables the identification of adherence levels as well as potential patterns of nonadherence, supporting its usefulness in both clinical practice and research. Routine use of the TAI may facilitate early detection of nonadherence and help guide targeted interventions to improve disease management.

Ethics Committee Approval

The study was approved by the İzmir Katip Çelebi University Non-interventional Clinical Research Ethics Committee (No: 0111-0112, Date: 21/03/2024).

Informed Consent

Written informed consent was obtained from all participants.

Conflicts of Interest

The authors have no conflicts of interest to declare.

Funding

The authors declared that this study received no financial support.

Use of AI for Writing Assistance

Artificial intelligence tools were used for the preparation of figures.

Author Contributions

Concept – M.Y.Y., M.O.T., S.G., Ç.C.Ö., M.K.S., C.M., B.S.; Design – M.Y.Y., M.O.T., S.G., Ç.C.Ö., M.K.S., C.M., B.S.; Supervision – M.Y.Y., M.O.T., S.G., Ç.C.Ö., M.K.S., C.M., B.S.; Resource – M.Y.Y., M.O.T., S.G., Ç.C.Ö., M.K.S., C.M., B.S.; Materials – M.Y.Y., M.O.T., S.G., Ç.C.Ö., M.K.S., C.M., B.S.; Data Collection and/or Processing – M.Y.Y., M.O.T., S.G., Ç.C.Ö., M.K.S., C.M., B.S.; Analysis and/or Interpretation – M.Y.Y., M.O.T., S.G., Ç.C.Ö., M.K.S., C.M., B.S.; Literature Review – M.Y.Y., M.O.T., S.G., Ç.C.Ö., M.K.S., C.M., B.S.; Writing – M.Y.Y., M.O.T., S.G., Ç.C.Ö., M.K.S., C.M., B.S.; Critical Review – M.Y.Y., M.O.T., S.G., Ç.C.Ö., M.K.S., C.M., B.S.

Peer-review

Externally peer-reviewed.

References

1. World Health Organization. Adherence to long-term therapies: evidence for action. Geneva: World Health Organization; 2003. https://www.paho.org/sites/default/files/WHO-Adherence-Long-Term-Therapies-Eng-2003.pdf Accessed Mar 11, 2026.
2. Engelkes M, Janssens HM, de Jongste JC, Sturkenboom MC, Verhamme KM. Medication adherence and the risk of severe asthma exacerbations: a systematic review. Eur Respir J 2015;45(2):396–407. [CrossRef]
3. Vrijens B, De Geest S, Hughes DA, Przemyslaw K, Demonceau J, Ruppar T, et al.; ABC Project Team. A new taxonomy for describing and defining adherence to medications. Br J Clin Pharmacol 2012;73(5):691–705. [CrossRef]
4. Melani AS, Bonavia M, Cilenti V, Cinti C, Lodi M, Martucci P, et al. Inhaler mishandling remains common in real life and is associated with reduced disease control. Respir Med 2011;105(6):930–8. Erratum in: Respir Med 2012;106(5):757. [CrossRef]
5. George M. Adherence in Asthma and COPD: New Strategies for an Old Problem. Respir Care 2018;63(6):818–31. [CrossRef]
6. Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention: 2025 update. https://ginasthma.org/2025-gina-strategy-report/ Accessed Mar 11, 2026.
7. Global Initiative for Chronic Obstructive Lung Disease. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease: 2025 report. https://goldcopd.org/2025-gold-report/ Accessed Mar 11, 2026.
8. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. Med Care 1986;24(1):67–74. [CrossRef]
9. Cohen JL, Mann DM, Wisnivesky JP, Home R, Leventhal H, Musumeci-Szabó TJ, et al. Assessing the validity of self-reported medication adherence among inner-city asthmatic adults: the Medication Adherence Report Scale for Asthma. Ann Allergy Asthma Immunol 2009;103(4):325–31. [CrossRef]
10. Toelle BG, Marks GB, Dunn SM. Validation of the inhaler adherence questionnaire. BMC Psychol 2020;8(1):95. [CrossRef]
11. Fukutani E, Wakahara K, Nakamura S, Yokoi E, Yoshimi A, Miyazaki M, et al. Inhalation adherence for asthma and COPD improved during the COVID-19 pandemic: a questionnaire survey at a university hospital in Japan. J Asthma 2023;60(11):2002–13. [CrossRef]
12. Nassar RI, Saini B, Obeidat NM, Basheti IA. Development and validation of the Adherence to Asthma Medication Questionnaire (AAMQ). Pharm Pract (Granada) 2022;20(2):2673. [CrossRef]
13. Oğuzülgen IK, Köktürk N, Işikdoğan Z. Turkish validation study of Morisky 8-item medication adherence questionnaire (MMAS-8) in patients with asthma and chronic obstructive pulmonary disease. Tuberk Toraks 2014;62(2):101–7. Turkish. [CrossRef]
14. Plaza V, Fernández-Rodríguez C, Melero C, Cosío BG, Entrenas LM, de Llano LP, et al; TAI Study Group. Validation of the 'Test of the Adherence to Inhalers' (TAI) for Asthma and COPD Patients. J Aerosol Med Pulm Drug Deliv 2016;29(2):142–52. [CrossRef]
15. Plaza V, López-Viña A, Entrenas LM, Fernández-Rodríguez C, Melero C, Pérez-Llano L, et al. Differences in Adherence and Non-Adherence Behaviour Patterns to Inhaler Devices Between COPD and Asthma Patients. COPD 2016;13(5):547–54. [CrossRef]
16. Khosravi S, Chaman R, Yaghoubi M, Zare F, Shahsavari S. Adherence to medication in patients with chronic diseases: a systematic review. Patient Prefer Adherence 2019;13:1693–9. [CrossRef]
17. Muneswarao J, Hassali MA, Ibrahim B, Saini B, Naqvi AA, Hyder Ali IA, et al. Translation and validation of the Test of Adherence to Inhalers (TAI) questionnaire among adult patients with asthma in Malaysia. J Asthma 2021;58(9):1229–36. [CrossRef]
18. Wang YH, Yang TM, Fang TP, Ou HT, Yang SC, Huang CM, et al. Validation of the Test of Adherence to Inhalers (TAI) among Taiwanese Patients with Chronic Obstructive Pulmonary Disease. Med Sci Monit 2025;31:e948762. [CrossRef]
19. Quirke-McFarlane S, Weinman J, d'Ancona G. A Systematic Review of Patient-Reported Adherence Measures in Asthma: Which Questionnaire Is Most Useful in Clinical Practice? J Allergy Clin Immunol Pract 2023;11(8):2493–503. [CrossRef]