

Validation of the Italian version of the Test of Adherence to Inhalers (TAI)

Running title: Italian version of TAI

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Effective management of asthma requires long-term adherence to inhaled drug therapies [1].

Regular use of maintenance treatment is associated with disease control, reduction in morbidity and costs, and therefore improvement of Health Related Quality of Life (HRQoL) [2]. Despite these benefits, non-adherence to asthma therapy is still frequent in clinical practice, ranging from 40 to 80% [3].

Although no gold standard exists, there are several approaches to assess the level of adherence: biochemical measures, pharmacy refill, electronic monitoring and self-report questionnaires. They are all characterized by strengths and limitations. In clinical practice there is a need to assess treatment adherence and improve patient's engagement in shared decision-making and self-management. In order to be used into the workflow of routinary care, a tool must be valid, reliable, inexpensive, short and easy to complete, score and interpret.

Most of the available self-reported measures of medication have been developed to assess patient's behavior independently of the drug or route of administration [4]. The Test of Adherence to Inhalers (TAI) [5], is the only tailored tool to evaluate the adherence to inhalers in patients with chronic obstructive pulmonary disease (COPD) or asthma. It is composed of 12 items: the first ten are self-filled by the patient and evaluate the level of adherence; in the last two, the health professionals are asked to detect two possible causes of unwitting non-adherent behavior (patient's knowledge of prescribed regimen and inhaler technique). The questionnaire has been originally developed in Spain [5], and is available in many languages. The original Spanish TAI showed to be a valid and

reliable instrument [6] and its validity has been recently confirmed in Persian language [7]. We here describe the psychometric properties of the Italian version of TAI in terms of validity and reliability [8].

Adult asthmatic patients (≥ 18 years old) in treatment with inhaled therapy for at least two months, visiting community pharmacies employing clinical pharmacy specialists, were asked to participate to a monitoring program. Patients were assessed at baseline and after two months. At the first visit, socio-demographic data, disease patterns, smoking habits, and current treatment were collected. At each visit patients were administered the Italian version of TAI and Asthma Control Test (ACT) [9].

A factor analysis was also carried out to determine scale dimensionality. Convergent validity was performed by Spearman's correlations to examine the relationships between TAI and ACT. The Cronbach's alpha coefficient for the whole instrument was used to determine the TAI's internal consistency. To ascertain the reliability of TAI the test-retest interclass coefficient (ICC) for each item and for the whole questionnaire.

The study population comprised 81 patients, 43 of whom were women, with a mean (DS) age of 53.6 (16,2) years. Twenty-two were smokers. The majority of patients got academic degree or high school diploma (54), while the remaining had a secondary (15) and primary school (12). The asthma duration was ≤ 3 months in 10 patients, from 3 to 36 months in 5 patients and > 3 years in 61 patients. Meter Dose Inhaler (MDI) was the principal device for 44 patients and Dry Powder Inhaler (PDI) for 37. Mean (SD) ACT score was 19.0 (4,5). In 7 patients asthma was totally controlled, in 40 well controlled, and in 34 uncontrolled.

Factor analysis revealed a four-dimensional structure, which explained up to 70,08% of the total variance (Table I). TAI scores showed a significant correlation with the ACT (Spearman's correlation coefficient: 0.287, $p=0.009$). Cronbach's a coefficient of 0.759 for the whole instrument exceeded the minimum internal consistency standard of ≥ 70 recommended for group comparison.

All items showed a moderate-good reproducibility, with ICC values ranging from 0.17 to 0.85. The reliability of the whole questionnaire was good with an ICC of 7.6.

The results of our study confirms that Italian version of TAI meets the standards for good validity, internal consistency, and reliability. The factor analysis maintained the original distinction between items completed by the patient (items 1-10) and those completed by the health professionals (items 11 and 12). However, the first 10 items were grouped in three factors that refer to well-known subtypes of non-adherence. The first factor combined the items related to memory problems; the second factor had grouped items about the influence of subjective experiences; the third factor encompassed the items that detect the presence of practical difficulties. Moreover, on the basis of the factor analysis results, only item 9 (assigned to the fourth factor) might have been allocated to another domain (factor three). As expected for two instruments that provide measure of different constructs, the correlation between TAI and ACT was low but significant, with sign in the expected direction. The internal consistency is good, with Cronbach α values that exceeded the recommended threshold [10]. Results of ICC, although lower than those seen for the original instrument and for the Persian language version, indicate a satisfactory reliability.

In conclusion we confirmed that the Italian version of TAI is a valid and reliable tool to identify and monitor non-adherence. Considering its psychometric characteristics, the questionnaire is suitable for use both in research and clinical setting in the Italian context. Future studies should aim to confirm our findings in larger cohorts. Moreover, it would be of great interest to explore the psychometric properties that have not yet been determined: the responsiveness and the minimal detectable change that in TAI scores that may improve health outcomes.

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Conflicts of Interest

Dr. Canonica reports grants and personal fees from Menarini, Alk Abello', Anallergo, Boehringer Ingelheim, Chiesi, Circassia, Genentech, Guidotti Malesci, GSK, Hal Allergy, Meda, Merck, Merck Sharp & Dome, Novartis, Recordati-InnuvaPharma, Roche, Sanofi, Stallergenes, UCB Pharma, Uriach Pharma, Teva, Astrazeneca, Thermo Fisher, Valeas, Vibor Pharma, outside the submitted work.

Dr. Heffler reports personal fees from AstraZeneca, Sanofi, Novartis, Teva, GSK, Circassia, Boehringer Ingelheim, Valeas, Nestlè Purina, outside the submitted work.

The remaining authors have no conflicts of interest to declare.

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Table 1. Factors identified using principal components analysis on full data set (bold typeface shows the component upon which each item scored most highly)

	Factor 1	Factor 2	Factor 3	Factor 4
Item 1	0.224	0.921	0.066	0.102
Item 2	0.227	0.912	0.152	0.071
Item 3	0.758	0.221	0.022	0.103
Item 4	0.801	0.180	0.163	0.059
Item 5	0.736	0.095	0.049	-0.021
Item 6	0.454	0.150	0.445	0.112
Item 7	0.288	0.100	0.689	0.194
Item 8	0.616	0.079	0.207	0.318
Item 9	0.263	0.129	0.471	0.536
Item 10	-0.070	0.046	0.747	-0.130
Item 11	0.152	0.061	-0.215	0.701
Item 12	-0.005	0.048	0.167	0.711