

Determinants and Differences in Satisfaction with the Inhaler Among Patients with Asthma or COPD



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What is already known about this topic? Satisfaction with the inhaler is an important determinant of treatment adherence in patients with asthma and chronic obstructive pulmonary disease. Few studies have compared these groups to identify differences in satisfaction and to determine the factors associated with high inhaler satisfaction in both diseases.

What does this article add to our knowledge? This study identifies clinically relevant differences between these 2 patient populations in satisfaction with the inhaler, indicating that the specific diagnosis is less relevant to inhaler satisfaction than other variables (age, disease control, and training in inhalation technique).

How does this study impact current management guidelines? These findings—particularly the role of training on satisfaction with the inhaler—provide a clear target to improve satisfaction and thereby clinical outcomes.

BACKGROUND: Satisfaction with the inhaler is an important determinant of treatment adherence in patients with asthma and chronic obstructive pulmonary disease (COPD). However, few studies have compared these 2 groups to identify the factors associated with satisfaction with the inhaler.

OBJECTIVE: To assess and compare satisfaction with the inhaler in patients with asthma or COPD and to determine the variables associated with high inhaler satisfaction.

METHODS: A multicenter, cross-sectional study of 816 patients (406 with asthma and 410 with COPD) was conducted. Satisfaction was assessed with the Feeling of Satisfaction with Inhaler (FSI-10) questionnaire. All participants completed the Test of

Adherence to Inhalers and either the Asthma Control Test (ACT) or the COPD Assessment Test (CAT).

RESULTS: Overall, the asthma group was significantly more satisfied with the inhaler (mean [standard deviation] FSI-10 scores: 44.1 [6.5] vs 42.0 [7.7]; $P < .001$) and more satisfied on most (7 of 10; 70%) items. Patients with asthma were significantly more satisfied with the inhaler regardless of the adherence level or the type of nonadherence pattern. Younger age, good disease control (ACT ≥ 20 or CAT ≤ 10), previous inhaler training, and absence of unwitting nonadherence were all independently and significantly associated with high inhaler satisfaction.

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Abbreviations used

ACT- Asthma Control Test

CAT- COPD Assessment Test

COPD- Chronic obstructive pulmonary disease

FSI-10- Feeling of Satisfaction with Inhaler

TAI- Test of Adherence to Inhalers

CONCLUSIONS: Age, disease control, and training in inhalation technique all play a more significant role than the specific diagnosis in explaining satisfaction with the device in patients with asthma and COPD. These findings underscore the need to provide better training and more active monitoring of the inhalation technique to improve patient satisfaction, treatment adherence, and clinical outcomes. © 2019 The Authors. Published by Elsevier Inc. on behalf of the American Academy of Allergy, Asthma & Immunology. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>). (J Allergy Clin Immunol Pract 2020;8:645-53)

Key words: Asthma; Pulmonary disease; Chronic obstructive; Self-reported success; Patient compliance; Patient satisfaction; Nebulizers; Vaporizers

Suboptimal adherence to inhaler therapy is common among patients with asthma and chronic obstructive pulmonary disease (COPD),¹⁻³ frequently resulting in poor disease control and increased morbidity and mortality. A wide range of sociodemographic (eg, age, educational level) and clinical variables (eg, disease severity)⁴ may influence adherence to treatment. However, inhaler-related factors—ease of use, inhalation technique, and patient satisfaction with the inhaler—also play a key role in determining adherence.⁵⁻⁸ For this reason, clinical guidelines recommend individualized inhaler selection to ensure a good match between patient needs and the attributes of the particular device.^{9,10}

Numerous studies have assessed satisfaction with the inhaler in patients with asthma and COPD,^{6-8,11-20} some of them with a potential conflict of interest. Although several studies have included both patients with COPD and patients with asthma,^{11-13,18} most studies have grouped these patients into a single category when reporting results. As a result, it is not clear whether there are any relevant differences between these 2 groups in terms of inhaler satisfaction.²⁰ Although these 2 patient populations share many similarities,²¹ the numerous clinical and sociodemographic differences could potentially influence their relative satisfaction with the inhaler.² The limited evidence reported to date suggests that patients with asthma and COPD prioritize different inhaler attributes.^{7,11,17,20,22} However, more data are needed to better characterize the differences between these 2 populations with regard to satisfaction with the inhaler.²

The aim of the present cross-sectional, multi-institutional study was to assess and compare satisfaction with the inhaler in patients diagnosed with asthma or COPD and to determine the factors independently associated with increased inhaler satisfaction.

METHODS

Study design and patients

This was a cross-sectional, multicenter study designed to assess and compare satisfaction with the inhaler in patients with COPD or asthma. Satisfaction with the current inhaler was assessed with the

Feeling of Satisfaction with Inhaler (FSI-10) questionnaire.²³ Treatment adherence was assessed with the Test of Adherence to Inhalers (TAI),²⁴ a validated self-report instrument that also provides data on the type of nonadherence (erratic, deliberate, or unwitting).

Inclusion criteria were as follows: (1) age ≥ 18 years; (2) confirmed diagnosis of asthma or COPD according to the Global Initiative for Asthma criteria⁹ or the Global Initiative for Chronic Obstructive Lung Disease,²⁵ respectively; (3) treatment with inhalers (either pressurized metered dose inhaler or dry powder inhaler) for the last 6 or more months; and (4) signed informed consent.

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee of the Hospital de la Santa Creu i Sant Pau Barcelona (Spain) (CHI-ASM-2015-02[RETAI]). The study was registered with the Spanish Agency of Medicines and Medical Devices. Written informed consent was obtained from all participants. All personal data were maintained confidential and anonymized.

Study procedures

Clinicians from 26 hospitals or primary care centers in Spain participated in this study. In accordance with real-world practice, the 36 participating clinicians were recruited from several different medical specialties, including pulmonology (11 centers; 42.3%), allergology (5 centers; 19.2%), internal medicine (5 centers; 19.2%), and primary care (5 centers; 19.2%). Each participating institution was expected to recruit 30 consecutive patients during the 7-month study enrolment period (September 2016 to April 2017).

Study variables

All study variables were recorded in the study database by the treating physician during a single visit conducted in the course of routine care. Informed consent was obtained at this same visit.

The following sociodemographic variables were registered: sex, age, educational level, and occupational status. Clinical variables assessed at baseline were diagnosis, years since onset, pre- and postbronchodilation forced vital capacity and forced expiratory volume in 1 second, smoking status (years smoking and pack-years), and Charlson comorbidity index.

Inhaler-related variables included the following: number of inhalers used, inhaler training received (yes or no), and professional assessment of inhalation technique (yes or no). At the study visit, the treating physician verbally determined whether the patient had previously received training and verification of the inhalation technique by a health care professional.

All patients underwent spirometry testing, performed according to the Spanish Society of Pneumology and Thoracic Surgery guidelines²⁶ using the predicted values for the Mediterranean population.²⁷ Disease severity and control was assessed by the COPD Assessment Test (CAT)²⁸ or the Asthma Control Test (ACT), as appropriate.²⁹

Evaluation instruments

FSI-10. This is a validated 10-item, self-completed questionnaire that assesses patient satisfaction with the inhaler. Each question has 5 response options scored on a Likert scale ranging from 5 (very) to 1 (hardly at all). Total scores range from 10 to 50 points, with higher scores indicating greater satisfaction.²³ For purposes of the present study, we calculated the median FSI-10 score for the sample and then used this score as the cutoff value to differentiate between high and low satisfaction with the device.

TABLE I. Sociodemographic and clinical characteristics of the patients

Variable*	All (n = 816)	Asthma (n = 406)	COPD (n = 410)	P value†
Sociodemographic variables				
Age (y)	60.1 (17.2)	49.8 (16.7)	70.2 (10.2)	<.001
Sex, male, n (%)	445 (54.5)	129 (31.8)	316 (77.1)	<.001
Educational level: secondary or university level studies, n (%)	329 (40.3)	233 (57.4%)	96 (23.4)	<.001
Work status: employed, n (%)	263 (32.2)	211 (52.0)	52 (12.7)	<.001
Never smoker, n (%)	304 (37)	283 (70)	21 (5)	<.001
Clinical characteristics				
Years since diagnosis	12.7 (11.0)	16.0 (13.0)	9.4 (7.3)	<.001
Received training in inhaler use, n (%)	616 (75.5)	331 (81.5)	285 (69.5)	<.001
Proper inhaler technique verified, n (%)	602 (73.8)	325 (80.0)	277 (67.6)	<.001
Number of devices used (range, 1-4)	1.8 (0.7)	1.8 (0.7)	1.9 (0.7)	.059
Charlson comorbidity index	3.76 (2.48)	2.35 (1.67)	5.16 (2.36)	<.001
FEV ₁ (postBD)%	72.1 (25.2)	88.5 (18.3)	53.5 (17.9)	<.001
FEV ₁ /FVC (postBD)%	0.7 (0.3)	0.8 (0.3)	0.5 (0.1)	<.001
Disease control				
Mean ACT or CAT score	NA	19.3 (4.8)	17.1 (7.6)	NA
Uncontrolled disease (ACT <20 or CAT >10), n (%)	NA	176 (43.8%)	319 (77.8%)	<.001
Treatment adherence				
TAI-10 score	46.0 (6.0)	45.1 (6.6)	47.0 (5.2)	<.001
Level of adherence, n (%)‡				
Good	342 (41.9)	131 (32.3)	211 (51.5)	<.001
Intermediate	234 (28.7)	134 (33.0)	100 (24.4)	<.001
Poor	240 (29.4)	141 (34.7)	99 (24.1)	<.001
Type of nonadherence, n (%)§				
Erratic	447 (45.6)	262 (51.2)	185 (39.5)	<.001
Deliberate	295 (30.1)	166 (32.4)	129 (27.6)	<.005
Unwitting	238 (24.3)	84 (16.4)	154 (32.9)	<.001

ACT, Asthma Control Test; CAT, COPD Assessment Test; COPD, chronic obstructive pulmonary disease; FEV₁, forced expiratory volume in 1 second; FVC, forced vital capacity; NA, not applicable; postBD, postbronchodilator testing; TAI, Test of Adherence to Inhalers.

*All data given as means with standard deviation unless otherwise indicated.

†P values: Student's *t* test or χ^2 test, as appropriate.

‡Level of adherence defined as good (TAI-10 = 50 points), intermediate (46-49 points), or poor (≤ 45 points).

§The type of nonadherence was based on the 2 physician-rated items (11 and 12) on the TAI-12.

TAI. The TAI is a validated self-report instrument designed to assess adherence to inhaler therapy. There are 2 versions of this instrument: the TAI-10 and the TAI-12. The TAI-10 includes 10 patient-rated items with a total score ranging from 10 to 50; patients who score <50 are classified as nonadherent. The TAI-12 contains the same 10 items plus 2 additional physician-rated items designed to orient the type of nonadherent behavior, classified as erratic (due to forgetfulness), deliberate (intentional), or unwitting (due to insufficient understanding of the dosing schedule and/or poor inhalation technique).

Statistical analysis

The study was sized to obtain a 5% precision in the 95% confidence interval for estimation of a proportion of approximately 70%, in both patients with asthma and patients with COPD, allowing for 25% of invalid cases for the analysis. A descriptive analysis of the sociodemographic and baseline clinical characteristics of the study population was performed. Data are described as means (standard deviation) or n (%), as appropriate. A univariate analysis was performed to identify the study variables significantly associated with satisfaction with the inhaler (cutoff: FSI-10 ≥ 44), and these were then entered into a multivariate logistic regression model. For univariate comparisons, Student's *t* test was used for quantitative variables and the χ^2 test for categorical

variables. The Statistical Package for the Social Sciences, v. 23 (SPSS-IBM, Chicago, Ill) was used to perform the statistical analysis. Statistical significance was set at $P < .05$.

RESULTS

Sociodemographic and clinical characteristics

Table I shows the sociodemographic and clinical characteristics of the patient sample. A total of 824 patients were initially recruited; of these, 8 did not meet the inclusion criteria. Therefore, the final sample included a total of 816 patients (406 with asthma and 410 with COPD).

As expected, significant between-group differences on several study variables were observed (Table I). Patients in the COPD group were significantly older (mean age: 70.2 vs 49.8 years). A significantly higher proportion of the patients with asthma had received inhaler training (81.5% vs 69.5%) and verification of the inhalation technique (80% vs 67.6%). A significantly greater proportion of the COPD group had uncontrolled disease (77.8% vs 43.8%) despite being more treatment adherent (mean TAI-10 score: 47.0 vs 45.1). Patients with asthma were more likely to present an erratic (51.2% vs 39.5%) or deliberate (32.4% vs 27.6%)

TABLE II. Satisfaction with the inhaler: results for the FSI-10

	All (n = 816)		Asthma (n = 406)		COPD (n = 410)		P*
Total score, mean (SD)	NA		44.1 (6.5)		42.0 (7.7)		<.001
	n	Percent	n	Percent	n	Percent	
1. Has it been easy to learn how to use the inhaler?							<.001
Very	361	44.2	222	54.7	139	33.9	
Fairly	305	37.4	130	32.0	175	42.7	
Somewhat	83	10.2	29	7.1	54	13.2	
Not very	35	4.3	12	3.0	23	5.6	
Hardly at all	32	3.9	13	3.2	19	4.6	
2. Was it easy to prepare the inhaler for use?							<.001
Very	387	47.4	234	57.6	153	37.3	
Fairly	291	35.7	128	31.5	163	39.8	
Somewhat	77	9.4	19	4.7	58	14.1	
Not very	30	3.7	8	2.0	22	5.4	
Hardly at all	31	3.8	17	4.2	14	3.4	
3. Was it easy to use the inhaler?							<.001
Very	421	51.6	252	62.1	169	41.2	
Fairly	290	35.5	120	29.6	170	41.5	
Somewhat	60	7.4	18	4.4	42	10.2	
Not very	24	2.9	9	2.2	15	3.7	
Hardly at all	21	2.6	7	1.7	14	3.4	
4. Was it easy to keep the inhaler clean and in good working condition?							.009
Very	456	55.9	248	61.1	208	50.7	
Fairly	281	34.4	130	32.0	151	36.8	
Somewhat	43	5.3	14	3.4	29	7.1	
Not very	11	1.3	6	1.5	5	1.2	
Hardly at all	25	3.1	8	2.0	17	4.1	
5. Was it easy to continue normal activities with the use of the inhaler?							.239
Very	434	53.2	231	56.9	203	49.5	
Fairly	285	34.9	133	32.8	152	37.1	
Somewhat	60	7.4	27	6.7	33	8.0	
Not very	17	2.1	8	2.0	9	2.2	
Hardly at all	20	2.5	7	1.7	13	3.2	
6. Did the inhaler fit your lips comfortably?							.001
Very	441	54.0	247	60.8	194	47.3	
Fairly	283	34.7	131	32.3	152	37.1	
Somewhat	53	6.5	13	3.2	40	9.8	
Not very	17	2.1	4	1.0	13	3.2	
Hardly at all	22	2.7	11	2.7	11	2.7	
7. Was using the inhaler easy in terms of size and weight?							.014
Very	449	55.0	247	60.8	202	49.3	
Fairly	286	35.0	122	30.0	164	40.0	
Somewhat	44	5.4	18	4.4	26	6.3	
Not very	12	1.5	7	1.7	5	1.2	
Hardly at all	25	3.1	12	3.0	13	3.2	
8. Was it easy to carry the inhaler with you?							.820
Very	426	52.2	213	52.5	213	52.0	
Fairly	267	32.7	130	32.0	137	33.4	
Somewhat	76	9.3	42	10.3	34	8.3	
Not very	20	2.5	9	2.2	11	2.7	
Hardly at all	27	3.3	12	3.0	15	3.7	
9. After you have used the inhaler do you have the feeling that you used it correctly?							.276
Very	381	46.7	199	49.0	182	44.4	
Fairly	320	39.2	157	38.7	163	39.8	
Somewhat	82	10.0	32	7.9	50	12.2	

(continued)

TABLE II. (Continued)

	All (n = 816)		Asthma (n = 406)		COPD (n = 410)		P*
Not very	16	2.0	9	2.2	7	1.7	
Hardly at all	17	2.1	9	2.2	8	2.0	
10. Overall, considering your responses to the previous questions, were you satisfied with the inhaler?							.011
Very	414	50.7	225	55.4	189	46.1	
Fairly	342	41.9	162	39.9	180	43.9	
Somewhat	46	5.6	13	3.2	33	8.0	
Not very	4	0.5	2	0.5	2	0.5	
Hardly at all	10	1.2	4	1.0	6	1.5	

COPD, Chronic obstructive pulmonary disease; FSI-10, Feeling of Satisfaction with Inhaler; NA, not applicable; SD, standard deviation.
*P values from the χ^2 test and Student's *t* test (total score).

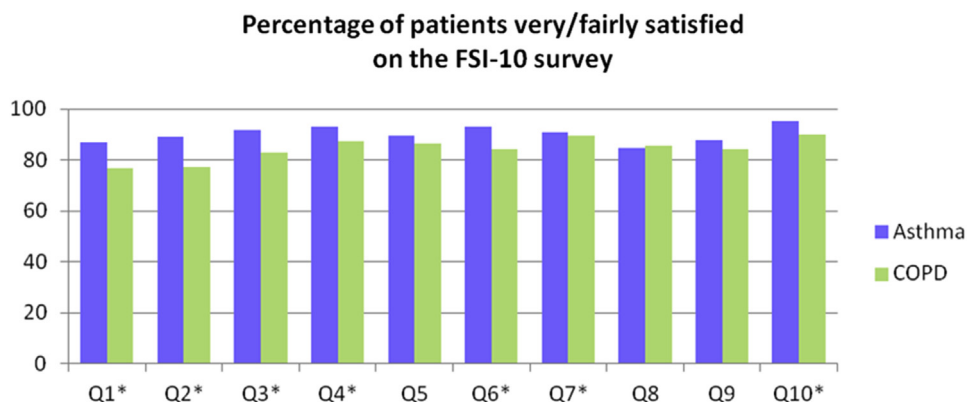


FIGURE 1. Percentage of patients very or fairly satisfied on the FSI-10 survey. COPD, Chronic obstructive pulmonary disease; FSI-10, Feeling of Satisfaction with Inhaler.

nonadherence pattern. The unwitting nonadherence pattern was more common in patients with COPD (32.9% vs 24.3%).

Satisfaction with the inhaler

Table II shows the FSI-10 scores by group and for the whole cohort. The asthma group was more satisfied overall (mean FSI-10 score: 44.1 vs 42.0; $P < .001$) and significantly more satisfied on 7 of the 10 FSI-10 items, with no significant between-group differences on the remaining 3 FSI-10 items (questions 5, 8, and 9).

Although $\geq 90\%$ of patients in both groups were “very” or “fairly” satisfied with the inhaler (item 10), the proportion of very or fairly satisfied patients was higher in the asthma group (95.3% vs 90.0%). These differences are depicted graphically in Figure 1, which shows the percentage of patients in each group who were very or fairly satisfied on each of the 10 items on the FSI-10 questionnaire.

Treatment satisfaction according to adherence level and patterns

Table III shows the mean FSI-10 scores in both groups according to the level of adherence and the type of nonadherence. Patients in the asthma group were more satisfied with the inhaler, regardless of the level of adherence or specific pattern of nonadherence (except for the unwitting pattern).

Correlation analyses

A Spearman’s correlation analysis for the whole sample showed a statistically significant ($P = .0001$) but weak positive correlation ($r = 0.168$) between treatment adherence (TAI-10) and satisfaction (FSI-10). Treatment adherence by group was also weakly correlated with inhaler satisfaction ($r = 0.168$ and $r = 0.158$ for COPD and asthma, respectively; $P = .001$).

A high ACT score in the asthma group was positively correlated with high inhaler satisfaction ($r = 0.174$; $P < .001$), suggesting that good disease control was associated with high inhaler satisfaction. A low CAT score in the COPD group was negatively correlated with satisfaction ($r = -0.274$; $P < .001$), also suggesting that low disease impact in this group was associated with high inhaler satisfaction.

Univariate analysis

The median FSI-10 score in the whole cohort was 44 points. Based on a cutoff value of FSI-10 ≥ 44 , satisfaction was considered high in 450 patients (55.2%) and low in 366 patients (44.8%).

Table IV shows the variables significantly associated ($P < .05$) with inhaler satisfaction (FSI-10 ≥ 44) on the univariate analysis. Two variables—asthma diagnosis and previous training in inhaler use—were significantly associated with high satisfaction, and 3 variables—older age, poor disease control, and unwitting nonadherence—were significantly associated with low satisfaction.

TABLE III. Treatment satisfaction (FSI-10 score) by level and type of adherence for each group

Variable	FSI-10 score, mean (SD)		P*
	Asthma	COPD	
Level of adherence [†]			
Good	44.6 (6.3)	42.7 (7.9)	.012
Intermediate	45.0 (5.4)	42.3 (7.2)	.002
Poor	42.6 (7.3)	40.5 (7.4)	.027
Pattern of nonadherence			
Erratic	43.8 (6.6)	41.3 (7.5)	<.001
Deliberate	43.0 (6.7)	40.7 (7.3)	.006
Unwitting	41.8 (7.9)	40.2 (7.5)	.111

COPD, Chronic obstructive pulmonary disease; FSI-10, Feeling of Satisfaction with Inhaler; SD, standard deviation; TAI, Test of Adherence to Inhalers.

*Student's *t* test.

†Level of adherence is defined as good (TAI-10 = 50 points), intermediate (46-49 points), or poor (<45 points). The pattern of adherence was based on items 11 and 12 on the TAI-12.

TABLE IV. Univariate analysis: association between study variables and satisfaction with the inhaler

Variable	FSI-10 <44 (n = 366), n (%)	FSI-10 ≥44 (n = 450), n (%)	P value*
Age, mean (SD)	63.3 (17.1)	58.5 (17.0)	<.001
Sex (male)	211 (5.7%)	234 (52.0%)	.107
Asthma diagnosis	154 (42.1%)	252 (56.0%)	<.001
Poor disease control (ACT <20 or CAT >10)	256 (69.9%)	239 (53.1%)	<.001
Previous training in inhaler use	248 (67.8%)	368 (81.8%)	<.001
Unwitting nonadherence	142 (38.8%)	96 (21.3%)	<.001
Level of adherence, TAI-10 (<50)	144 (39.3%)	198 (44.0%)	.180

ACT, Asthma Control Test; CAT, Chronic Obstructive Pulmonary Disease Assessment Test; FSI-10, Feeling of Satisfaction with Inhaler; SD, standard deviation; TAI, Test of Adherence to Inhalers.

*P values calculated with Student's *t* test or the χ^2 test.

On the multivariate analysis (Table V), 4 variables were significantly associated with high satisfaction (FSI-10 ≥44): (1) younger age; (2) good disease control; (3) previous inhaler training; and (4) absence of unwitting nonadherence pattern.

DISCUSSION

Patients with asthma were significantly more satisfied with the inhaler and significantly more satisfied on most (70%) of the 10 inhaler-related variables assessed on the FSI-10. These differences were maintained regardless of the specific adherence level (good, intermediate, or poor) and for 2 (erratic, deliberate) of the 3 nonadherence patterns (Table III). After adjusting for confounding variables (multivariate analysis), 4 variables were associated with high satisfaction with the inhaler: (1) younger age; (2) good disease control (ACT ≥20 or CAT ≤10); (3) previous inhaler training; and (4) absence of the unwitting nonadherence

TABLE V. Results of the multivariate logistic regression: variables significantly associated with high satisfaction with the inhaler (FSI-10 score ≥44)

Variable	OR (95% CI)	P*
Age	0.99 (0.98-1.00)	.049
Disease control (ACT ≥20 or CAT ≤10)	1.74 (1.28-2.36)	<.001
Training in inhalation technique	1.85 (1.32-2.50)	<.001
Absence of unwitting nonadherence pattern	1.82 (1.31- 2.52)	<.001

ACT, Asthma Control Test; CAT, Chronic Obstructive Pulmonary Disease Assessment Test; CI, confidence interval; FSI-10, Feeling of Satisfaction with Inhaler; OR, odds ratio.

*P value from Wald tests.

pattern. Notably, the diagnosis (asthma or COPD) was not significantly associated with satisfaction on the multivariate analysis. These findings indicate that variables other than diagnosis appear to explain the differences in satisfaction with the inhaler among patients with asthma and COPD.

Between-group differences according to the results of the FSI-10

Patients with asthma were significantly more satisfied with the inhaler overall (Table II), regardless of the level of adherence (Table III) or the pattern of nonadherence, except for the unwitting pattern, for which no between-group differences were observed.

If we group the patient responses on the 5-point scale (see Figure 1) into positive ("very" or "fairly satisfied") and negative responses ("not very" or "hardly at all" satisfied), the highest rated item in both groups was item 10 (overall satisfaction), which was rated positively by 95.3% and 90.0% of patients with asthma and COPD, respectively. The second highest rated item among patients with asthma (93.1%) was item 4 ("ease of keeping the inhaler clean and in good working condition"), whereas the second highest rated item among patients with COPD (89.3%) was item 7 ("size and weight"). By contrast, the 2 lowest rated items were the same in both groups: item 1 ("easy to learn": 6.2% and 10.2% of patients with asthma and COPD, respectively) and item 2 ("easy to prepare the inhaler for use": 6.2% and 8.8%, respectively).

There was a wide discrepancy between the groups with regard to the perceived ease of inhaler use (item 3), with 91.7% of patients with asthma finding the inhaler very or fairly easy to use versus "only" 82.7% of the patients with COPD. The most likely explanation for this difference is the greater proportion of patients in the asthma group (>80% vs 70%) who had received training and verification of the inhaler technique. However, the substantial age differences between the groups (patients in the COPD were, on average, 20 years older) probably also influenced the scores on this item because of the presence of more physical limitations and comorbidities.¹¹

Despite the clear differences in satisfaction between these groups, the results of the logistic regression analysis indicate that the diagnosis does not play a significant role in determining satisfaction with the inhaler. Rather, as the multivariate analysis shows, variables other than diagnosis were associated with high satisfaction with the inhaler: younger age, previous inhaler training, absence of the unwitting nonadherence pattern, and good disease control. These findings are consistent with the results of a study conducted previously by our group to determine

the impact of patient satisfaction with the inhaler on adherence and disease control in a large sample ($n = 778$) of patients with asthma.⁸ In that study, younger age, disease control, and treatment adherence were significantly associated with higher satisfaction with the inhaler (FSI-10). These findings are also in line with the results of another study by our group that compared differences in treatment adherence and in nonadherence patterns in patients with asthma and COPD,² finding several significant differences between the 2 groups on those outcome measures; however, when the analysis was adjusted for confounders, only 2 variables—younger age and active employment status (but not diagnosis)—were significantly associated with nonadherence.

Although published reports on the association between disease control and satisfaction with the inhaler are limited, our finding that disease control is correlated with inhaler satisfaction in the patients with asthma is consistent with other reports,^{7,14} including our previous study.⁸ In line with our findings in the asthma group, we observed a significant association between low disease impact and high inhaler satisfaction among the patients with COPD.

The multivariate analysis also revealed a significant association between the absence of the unwitting nonadherence pattern and high satisfaction with the inhaler. In other words, patients who presented an unwitting nonadherence (a failure to adhere to treatment due to forgetfulness, an inability to fully understand the dosing regimen, or poor inhalation technique) were less satisfied with the inhaler. Previous research⁶ has demonstrated that patients with this pattern of nonadherence tend to be older with some degree of cognitive and/or physical impairment, all of which are more characteristic of patients with COPD than patients with asthma. Not surprisingly, nearly 1 of every 3 patients with COPD in our study presented an unwitting nonadherence pattern versus only one sixth of the patients with asthma, an important difference that may partially explain the lower satisfaction scores on the FSI-10 in the COPD group.⁶

The significant association between previous training in inhalation technique and patient satisfaction was not unexpected, as patients who understand how to use the inhaler properly are less likely to be frustrated or confused—thus eliminating a potential cause of dissatisfaction—and therefore more satisfied. In this regard, patient responses on several FSI-10 items—particularly item 1 (ease of learning to use the inhaler)—underscore the importance of providing device-specific training. Item 1 was the lowest-rated item in both groups, with a substantial proportion of patients in the asthma and COPD groups (6.2% and 10.2%, respectively) reporting difficulty in learning to use the device. It also seems probable that the significant between-group differences on several other FSI-10 items (eg, items 2, 3, and 7; Table II) may be partially due to differences in inhaler training and verification. The significant association between previous training and satisfaction with the inhaler underscores the need to ensure that all patients—particularly those with COPD (who received less training and were less satisfied)—receive quality instruction and ongoing monitoring of their inhalation technique, as recommended in several previous reports³⁰⁻³² and clinical guidelines.^{9,25} Numerous studies have shown that errors in the inhalation technique are widespread in patients with COPD and asthma, regardless of their level of satisfaction with the inhaler.^{11,33} Some studies have even found that more than 90% of patients make at least 1 critical error.³² Moreover, a systematic review published in 2016 found that the

type and incidence of errors have remained largely unchanged in the last 40 years,³¹ highlighting the need for better training and more intuitive, easier to use inhalers. The findings of the present study—in which ease of use was the lowest rated item on the FSI-10 in both groups—would seem to support that conclusion.

Comparative data on differences between patients with asthma and COPD with regard to satisfaction with the inhaler are limited. Although a few studies^{11,20,22} have investigated differences in patient preferences between these 2 groups, none of those studies used a validated instrument such as the FSI-10. Moreover, none of those studies adjusted for confounding variables, thus making it difficult to identify the true determinants of satisfaction. The largest of these comparative studies was performed by Ding et al,¹¹ who conducted an international, cross-sectional study involving more than 7300 patients diagnosed with asthma, COPD, or asthma-COPD overlap syndrome in the context of routine care. Those authors administered an *ad hoc* survey that asked patients to rate their satisfaction with 12 different inhaler attributes. In the asthma group, the most highly rated feature was convenience (portability and minimal dose preparation). By contrast, robustness, reliability, and dose reproducibility were the most important characteristics for the patients with COPD. Despite the valuable data provided by that study, it is important to note that the influence of sociodemographic and clinical variables on these preferences was not assessed. Two other studies have also described differences among patients with asthma and COPD in terms of the inhaler attributes.^{17,22} Hawken et al²² surveyed 294 patients with asthma ($n = 201$) or COPD ($n = 93$), finding that the most important feature for patients with asthma was the number of steps required for dose preparation; by contrast, patients with COPD most valued an inhaler that could be used during episodes of breathing difficulties. Finally, in a real-world study designed to evaluate satisfaction with a specific inhaler (Easyhaler), Gálffy et al¹⁷ found that a higher percentage of patients with asthma were very satisfied with the device (52.6%) than those with COPD (33.4%), a finding that is consistent with our data (55.4% and 46.1%, respectively). However, in contrast to our findings, those authors did not find any age-related differences in satisfaction with the inhaler.

Although the findings from the aforementioned studies suggest that there may be small differences between patients with asthma and COPD in terms of device preferences and satisfaction, more research is needed to ascertain whether these differences are due to factors other than the diagnosis. Although there may well be differences between patients with asthma and COPD in terms of preferences for certain device attributes, as Ding et al concluded, these preferences could be attributable to variables other than the specific respiratory condition.

Study strengths and limitations

The present study has several limitations. First, our results could have been influenced by the specific mix of devices used by patients in this study. That said, the real-world study design reflects the heterogeneity of routine clinical practice. Second, limitations inherent to the FSI-10 scale may also have influenced our results, as no minimum score has been established to determine clinically relevant differences and the cutoff level to distinguish between high and low satisfaction was arbitrary. Nonetheless, the median score on the FSI-10 in the current study was virtually the same as the median

value obtained in a previous study (44 and 43 points, respectively).⁸ Third, although the TAI has been validated against electronic monitoring devices, it is worth noting that the validation study²⁴ found that electronic data showed higher adherence scores and lower nonadherence scores versus the TAI. Fourth, most of the participating physicians in this study were specialists (only 22.2% were general practitioners), which could have biased sample selection. Finally, the cross-sectional study design provides only a “snapshot” of patient satisfaction, which is likely to vary over time due to the chronic nature of these pathologies. By contrast, an important strength of this study is that it is the first to directly compare inhaler satisfaction in a large cohort of patients with COPD and asthma.

CONCLUSIONS

Our findings suggest that variables such as age, disease control, and training in inhalation technique all play a more significant role than the diagnosis in explaining satisfaction with the device among patients with asthma or COPD.

Given the important role of patient satisfaction in treatment adherence, these findings underscore the need for better training and more active monitoring of inhalation technique to improve satisfaction with the inhaler and thus treatment adherence and clinical outcomes.

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VP takes responsibility for the integrity of the work as a whole and had full access to all data, including adverse effects. VP drafted the manuscript with critical revision from all co-authors. VP, JG, EC, MBO, MIO, JMV, and BGC all contributed substantially to the study design, data analysis and interpretation, and manuscript preparation.

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