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Inadequate inhaler technique, an everlasting problem associated with poor disease control — a cross-sectional study

Abstract

Introduction: Dry powder inhalers (DPI) have been in use in the treatment of chronic respiratory diseases for decades. DPIs require proper inhaler technique to ensure appropriate dose delivery to the lungs which in turn provides disease control and hence reduces the economic burden due to frequent acute attacks and hospital visits. Inadequate inhaler technique remains an everlasting problem among patients with chronic respiratory disease. Hence the aim is to assess the inhaler technique in patients using DPI and to determine the factors associated with inhaler technique.

Material and methods: A cross-sectional study was conducted and 385 patients with asthma or chronic obstructive pulmonary disease (COPD) were recruited. Patient-related and disease-related factors were noted. Severity of the disease were assessed using asthma control test/COPD assessment test questionnaire and spirometer. The investigator assessed the inhaler technique of the patient against standard checklist.

Results: Nearly 46.2% of the patients performed incorrect inhaler technique. Multivariate analysis showed factors like young age [Odd's ratio (OR) 4.13, CI 1.31–17.8], well controlled disease (OR 2, CI 1.1–3.65), and the patients who learnt the technique from a medical personnel (OR 3.67, CI 1.46–9.24) had better inhaler technique.

Conclusion: This study shows that the proper use of inhaler is still an unattained goal and significance of correct use has to be reiterated.

Key words: adults, asthma, chronic obstructive pulmonary disease, dry powder inhaler, spirometry

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Introduction

Bronchial asthma and chronic obstructive pulmonary disease (COPD) are the most common chronic lung diseases. Globally, 1–8% of the population are affected by bronchial asthma [1] and about 11.7% of people are diagnosed with COPD [2]. In India, among adults, 2–12% are affected by asthma [1] and 6.5–7.7% by COPD [3]. Even though they form two distinct diseases with different pathophysiology, disease progression, prognosis and treatment options, they manifest with similar symptoms like cough, wheezing and shortness of breath. These two diseases are incurable, but managed symptomatically using anti-inflammatory drugs and bronchodilators [4].

Inhalers have been in use for decades in the treatment of these chronic respiratory diseases. They are preferred over other dosage forms due to their local effect, immediate onset of action and reduced side effects. Unlike other dosage forms, inhalers require a proper technique to ensure appropriate dose delivery to the lungs. Dry powder inhalers (DPIs) are breath-actuated and require forceful inhalation for appropriate dose delivery to the lungs and need less hand-mouth coordination for actuation and inhalation unlike metered-dose inhalers (MDI) [5]. Holding the head in a chin up position and gargling after inhalation are also essential for proper drug delivery and the reduction of side effects [6]. The inhaler technique in the last four decades was a poor method among 31% of the patients using DPI,

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and it was revealed that there was no significant improvement over the years [7]. A study showed that 86% of the users in India did not use inhalers properly [8]. Similar results were seen in another study in which only 21% of patients demonstrated a correct technique while using the inhaler [9].

GINA and GOLD guidelines emphasize the need to check the inhaler technique of every person with asthma or COPD, respectively. Incorrect inhaler technique is considered to be a risk factor for exacerbation and also for adverse effects of drugs. The guidelines also emphasize the need to check the inhaler technique before stepping up the treatment [1, 2].

Many studies have found patient-related and disease-related factors like age, sex, education, place of living, duration of disease, duration of inhaler use, disease severity to be associated with the inhaler technique [10]. The factors affecting the inhaler technique vary in different populations. Identifying these factors can help caregivers to focus in the respective areas to improve the technique. The effective use of inhalers needs to be ensured to reduce the economic burden due to frequent acute attacks and hospital visits [11].

Hence the aim of the study is to assess the inhaler technique among patients with chronic respiratory disease using DPI and determine the factors associated with the inhaler technique.

Materials and methods

This study was conducted in a tertiary care hospital located in the union territory of Puducherry, amid the state of Tamil Nadu in South India. The hospital provides drugs free of cost and caters to the healthcare needs of people residing in this union territory and also many districts of Tamil Nadu in south India.

Sample size

The sample size was calculated as 385 in OpenEpi with an anticipated frequency of 50%, absolute precision at 5% and power at 80%. A total of 385 patients diagnosed with bronchial asthma or COPD were recruited from the outpatient departments of General Medicine and Pulmonary Medicine of this tertiary care hospital by consecutive non-random sampling for this cross-sectional study. The study was approved by the Institute Ethics Committee (JIP/IEC/2015/15/571 dated 30.06.2015).

Inclusion/exclusion criteria

In the study, patients between age 14 and 80 years who had been using a Rotahaler at least for three months were included. Patients for whom spirometry was contraindicated — due to recent surgery, pneumothorax, hemothorax, recent myocardial infarction, pulmonary embolism, cerebral aneurysm, and lactating or pregnant women were excluded.

Informed consent was obtained before the start of the study. Patient-related factors like age, sex, education, and place of living, were obtained from the subjects directly and also from their case records. Socioeconomic status of the patient was classified based on Prasad's social classification of 2017, which is an online tool for socioeconomic classifications [12, 13].

Assessment of the severity of the disease

The disease was classified as mild, moderate and severe based on forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC) values from spirometry done with nSpire HDPFT 4000 plethysmograph. Asthma control test (ACT) or COPD assessment test (CAT) questionnaire was also used to assess the severity of the disease. Other disease-related factors like the number of acute attacks per month, number of hospital visits in the last six months, duration of disease and duration of inhaler use were also obtained from the patients.

Inhaler technique score

The investigator assessed the inhaler technique using the checklist in Table 1 that contains eight steps based on the checklist issued by the Dutch Asthma Foundation for Rotahaler. For every correct step, a score of 1 was given. Hence, the patient with score 8 was considered having a good inhaler technique. The steps for assessing the inhaler technique were divided into essential and non-essential for analysis. Priming the DPI and deep inhalation are essential steps which ensure optimal drug delivery to the lungs. The primary outcome variable is the good or poor inhaler technique based on essential and non-essential steps. The chin-up position during inhalation and gargling after inhaler use were noted. The person who taught the inhaler technique to the patient was also written down.

Statistical tests

Baseline characteristics of the study population were reported by means of descriptive statistics. Categorical variables like age, gender, place of living, educational qualification, socioeconomic status, smoking history, exposure to biomass fuel, disease, duration of disease,

Table 1. Steps for assessment of inhaler technique and the different errors committed by patient in each step

No.	Steps	Errors
1.	Hold the Rotahaler vertically	• Not aware how to load the rotacaps • Takes help from family members for loading • Interior of Rotahaler is covered with white powder, not washed or cleaned • Uses old Rotahaler that does not break capsules properly • Opens the cap of Rotahaler and empties the contents of the rotacaps inside the Rotahaler • Does not close the capsule holder
2.	Take the Rotahaler capsule, insert transparent end first into the raised square hole of the Rotahaler*	
3.	Press the rotacap firmly such the top of the capsule comes to same level as raised square hole of Rotahaler*	
4.	Hold the mouthpiece firmly with one hand and rotate the base with the other*	
5.	Breathe out fully	• Does not breath out to the reserve volume
6.	Grip the mouthpiece between your teeth and seal your lips around it	• Keeps on the lips instead of inside the mouth • Inhales through nose • Does multiple inhalations for one dose
7.	Breathe in through your mouth as deeply as you can*	• Does not inhale forcefully, rattling sound of capsule not heard • Does not start with forceful inhalation
8.	Remove the Rotahaler from mouth and hold your breath for as long as comfortable (10 sec) before breathing out	• Most commonly missed step • Keeps mouth closed but exhales through nose

*Indicates essential steps

duration of the inhaler use, hospital visits, acute attacks, ACT/CAT score, PFT and categorizations of persons from whom patients learned the inhaler technique were expressed as frequency and percentages. Chi^2 test was used to study the association of the correct inhaler technique with all patient-related and disease-related factors. Binary logistic regression was used to find the degree of association between the inhaler technique and the studied variables. Odds ratio, along with confidence interval, was estimated to quantify the risk in different categories among the variables for a proper inhaler technique. All statistical analyses were performed at a 5% level of significance and p-value < 0.05 was considered as significant. The analysis was done using IBM SPSS software version 19.

Results

The baseline characteristics of the study population depicted in Table 2 reflects the nature of the study group. About half the population, 184 patients (47.8%) had no formal education, and about 300 patients (77%) lived in rural areas. Biomass fuel usage was reported in 192 (50%) patients and 287 subjects (75%) were of lower and upper-lower socioeconomic status. Bronchial asthma patients — 289 (75%) outnumbered the COPD patients.

The duration of the disease ranged from three months to 50 years with a median of eight years. The duration of the inhaler use ranged from three months to 25 years with a median of three years. All

Table 2. Baseline patient characteristics

Variable	Descriptive statistics
Age (mean ± SD)	50.45 ± 15.49 yrs
Male (mean ± SD)	53.14 ± 17 yrs
Female (mean ± SD)	48.36 ± 13.85 yrs
Duration of disease [median (IQR)]	8 (4–15) yrs
Duration of inhaler use [median (IQR)]	4 (2–7) yrs
FEV_1 % predicted (mean ± SD)	62.83 ± 21.49
PEFR % predicted (mean ± SD)	57.76 ± 24.51

FEV_1 — forced expiratory volume in 1 second; IQR — interquartile range; PEFR — peak expiratory flow rate; SD — standard deviation

patients were prescribed salbutamol sulfate 200 mcg and beclomethasone dipropionate 200 mcg Rotacaps as reliever and controller drugs, respectively, for treatment of their chronic respiratory disease. Apart from these drugs, patients would also receive etophylline and theophylline fixed -dose combination tablets and/or cough syrup for better symptom control. Spirometry revealed 43% of the patients to have severe disease. ACT/ /CAT questionnaire disclosed that 37% of the patients had the uncontrolled disease and 58% of the patients had visited the hospital at least once in the last six months for the treatment of acute exacerbation.

The common errors made by the patients in each step of the inhaler technique are listed in Table 1. Almost all subjects made at least one error in the inhaler technique. When classified as a correct and incorrect technique based

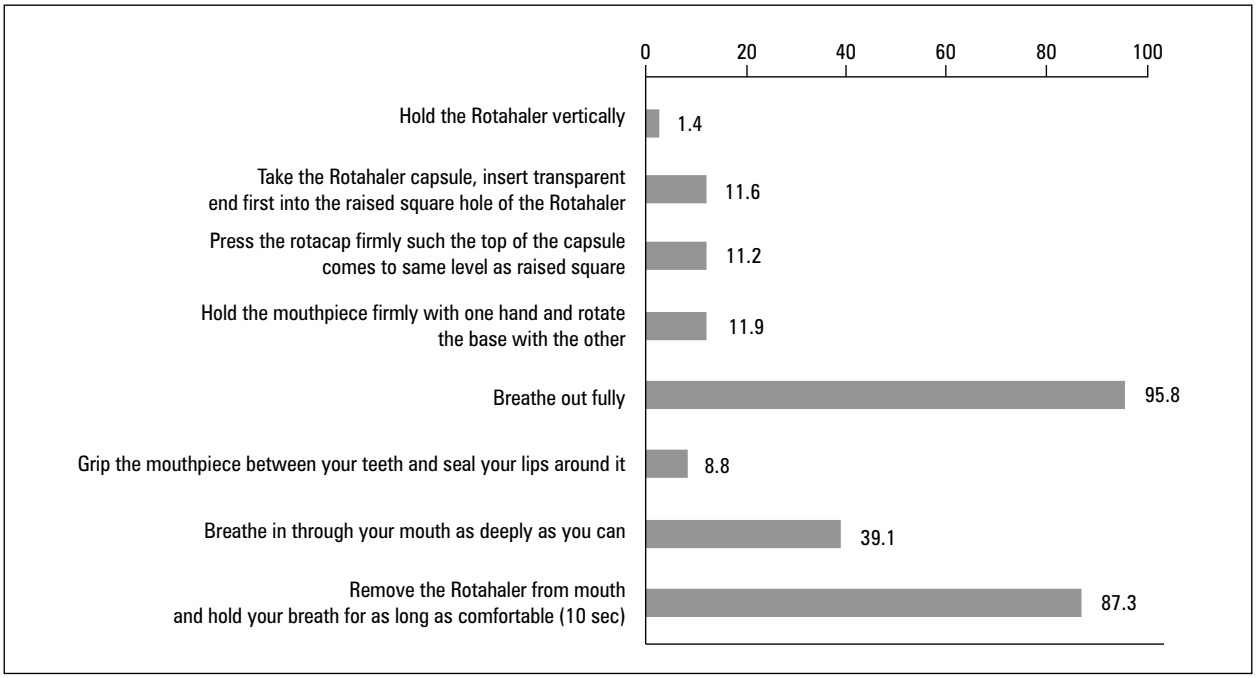

Figure 1. Percentage of patients committing error in each step of inhaler use

on essential steps, 46% of the patients had an incorrect technique. Breathing out before inhalation (95.8%) and holding the breath for 10 seconds after inhalation (87.3%) were the most commonly missed steps (Figure 1). Gargling was omitted by 87.5% of the study population and inhaling in chin down position was noted in 75.6% of the study population. The pharmacist had taught the inhaler technique to 55% of the study population.

Patient-related factors like age ($p = 0.0001$), place of living ($p = 0.04$) and education ($p = 0.013$) were significantly associated with the inhaler technique (Table 3). Patients with higher education had a good inhaler technique compared to patients with no formal education [Odds ratio (OR) 3.4 confidence interval (CI of 1.31–8.87)]. Bronchial asthma patients employed a better inhaler technique compared to COPD patients [OR 1.81 (CI 1.14–2.89)] (Table 4). There was also a significant association found between the inhaler technique and disease severity assessed both with the questionnaire and spirometry. Patients with good control of disease were using good inhaler technique, which was found from the questionnaire [OR 2.73 (CI 1.69–4.42)] and spirometry [OR 2.65 (CI 1.55-4.52)]. The patients who learned the inhaler technique from the doctor had OR of 3.61 (1.54–8.45), compared to learning the technique from a non-medical person like their relatives, friends or other asthma patients.

A multivariate analysis showed education (OR 4.83, CI 1.31–17.8), the severity of the disease (OR 2, CI 1.1-3.65) and the instructor who taught the technique (OR 3.67, CI 1.46–9.24) were significantly associated with the inhaler technique (Table 5).

Discussion

This study revealed that nearly half of the study population demonstrated improper inhaler technique, which is reflected on the severity of the disease. Majority of the population has no formal education. A significant association of the inhaler technique with healthcare professional teaching the technique to patients emphasizes their vital role in patient care.

The study also revealed that all patients committed at least one error in the use of an inhaler. The basic step of loading the capsule was a major obstacle for old patients. They either require the assistance of family members or they use an alternate method like breaking the capsule in hand and emptying the powder inside the Rotahaler. They leave the hole for capsule holder unfilled, which leads to a loss of drug through this hole. A review conducted by Gibson *et al*. in older adults has shown that dry powder inhalers should not be used in patients with less peak inspiratory flow, and their use is questionable in patients with cognitive impairment and decreased

Table 3. Association and the degree of association of patient characteristics with inhaler technique

Variable	Status	Correct technique (n = 207)	Incorrect technique (n = 178)	χ^2 (p-value)	Odds ratio (95% CI)
Age	14–30 (n = 44)	37 (84.1)	7 (15.9)	**23.104 (0.000)**	**5.64 (1.93–16.47)**
	31–50 (n = 147)	83 (56.5)	64 (43.5)		1.38 (0.64–3.0)
	51–70 (n = 163)	72 (44.2)	91 (55.8)		0.84 (0.39–1.81)
	70+ (n = 31)	15 (48.4)	16 (51.6)		**Reference**
Gender	Male (n = 169)	94 (55.6)	45 (44.4)	0.417 (0.518)	1.14 (0.76–1.71)
	Female (216)	113 (52.3)	103 (47.7)		**Reference**
Place of living	Rural (n = 300)	153 (51)	147 (49)	4.183 (0.041)	**Reference**
	Urban (n = 85)	54 (63.5)	31(36.5)		**1.67 (1.02–2.75)**
Educational qualification	No formal education (n = 184)	91 (49.5)	93 (50.5)	**10.791 (0.013)**	**Reference**
	1–5 yrs (n = 99)	48 (48.5)	51 (51.5)		0.96 (0.590–1.57)
	6–12 yrs (n = 76)	48 (63.2)	28 (36.8)		**1.75 (1.01–3.03)**
	Graduate (n = 26)	20 (76.9)	6 (23.1)		**3.41 (1.31–8.87)**
Socio-economic status	Lower (n = 80)	38 (47.5)	42 (52.5)	5.193 (0.206)	**Reference**
	Upper lower (n = 207)	107 (51.7)	100 (48.3)		1.18 (0.71–1.98)
	Lower middle (n = 69)	42 (60.9)	27 (39.1)		1.72 (0.89–3.30)
	Upper middle + upper (n = 24)	17 (70.8)	7 (29.2)		2.46 (0.99–6.05)
Biomass fuel exposure	Yes (n = 192)	103 (53.65)	89 (46.35)	0.002 (0.962)	0.99 (0.66–1.48)
	No (n = 193)	104 (53.89)	89 (46.11)		**Reference**
Smoking history	Non exposure (n = 241)	139 (57.7)	102 (42.3)	6.64 (0.084)	0.84 (0.48–1.46)
	Ex-smoker (n = 77)	34 (44.2)	43 (55.8)		0.58 (0.35–0.97)
	Passive smoker (n = 62)	33 (53.2)	29 (46.8)		0.18 (0.2–1.67)
	Current smoker (n = 5)	1 (20)	4 (80)		**Reference**

Categorical variables are represented as n (%). Chi^2 value (χ^2) was done to find the association of the variables with inhaler technique. The p value of < 0.05 was considered as significant. The results were adjusted for false discovery rate with Benjamini-Hochberg correction. Odds ratio with 95% CI was done to find the degree of association. The significant results are highlighted

manual dexterity which are common problems in old age [14]. Manriquez *et al*. assessed the inhaler technique of adults and pediatrics and revealed that adults above 60 years of age committed more errors compared to younger patients [15].

The most common missed step was holding the breath for 10 seconds after inhalation. This step ensures that the powdered drug reaches the lung and makes contact with the receptors. The contact time should be adequate for the drug to exert its action. Exhalation immediately after inhalation reduces the contact time and hence does not produce adequate action [6]. Exhaling to residual volume prior to inhalation was the next step missed by the majority of the patients. This increases the median peak inspiratory flow rate, inhaled volume of air, and the rate of flow [16]. A review of articles from 1975 to 2014 by Sanchis *et al*. revealed that these two steps were the most commonly missed steps among people who use DPI, and the same was seen also in our study [17]. A multinational cross-sectional study of 3681 patients conducted in seven European countries and Australia also revealed that these two steps were the most commonly missed steps when using DPI [18]. A study conducted in western India also showed a similar result [8].

The DPIs are breath-actuated and dose delivery depends on the inspiratory flow to break the powdered drug into fine particles and deliver them to the small airways. The Rotahaler requires an inspiratory flow rate of 90 L/min for optimal drug delivery. This is an essential step in the use of the inhaler technique as it ensures that the optimal amount of drug reaches the lungs allowing the disease control. This was missed by about 40% of the patients in this study group. A review of articles from 2011 to 2014 including over 5000 patients showed that there is a significant association between insufficient

Table 4. Association and the degree association of disease-related variables with inhaler technique

Variable	Status	Correct technique (n = 207)	Incorrect technique (n = 178)	χ^2 (p-value)	Odds ratio (95% CI)
Disease	Asthma (n = 289)	166 (57.4)	123 (42.6)	**6.291 (0.012)**	**1.81 (1.14–2.89)**
	COPD (n = 96)	41 (51.6)	55 (57.3)		**Reference**
Duration of disease	3 mo to 5 yrs (n = 127)	70 (55.1)	57 (44.9)	4.408 (0.354)	1.50 (0.81–2.78)
	6–10 yrs (n = 118)	67 (56.8)	51 (43.2)		1.61 (0.86–3)
	11–15 yrs (n = 54)	32 (59.3)	22 (40.7)		1.78 (0.85–3.74)
	16–20 yrs (n = 26)	11 (42.3)	15 (57.7)		0.89 (0.35–2.27)
	More than 20 (n = 60)	27 (45)	33 (55)		**Reference**
Duration of inhaler use	3 mo to 3 yrs (n = 186)	95 (51.1)	91 (48.9)	1.09 (0.580)	**Reference**
	3–6 yrs (n = 99)	55 (55.6)	44 (44.4)		1.19 (0.73–1.95)
	More than 6 yrs (n = 100)	57 (57)	43 (43)		1.27 (0.78–2.07)
Hospital visit	None (n = 159)	88 (55.3)	71 (44.7)	1.454 (0.483)	1.32 (0.79–2.19)
	One (n = 131)	73 (55.7)	58 (44.3)		1.34 (0.79–2.28)
	Two or more (n = 95)	46 (48.8)	49 (51.6)		**Reference**
Acute attack	No attacks (n = 136)	83 (61)	53 (39)	6.489 (0.09)	1.34 (0.8–2.25)
	Once or twice monthly (n = 51)	28 (51.9)	26 (41.1)		0.92 (0.48–1.78)
	Once weekly (n = 91)	40 (44)	51 (56)		0.67 (0.38–1.18)
	Twice or more weekly (n = 104)	56 (53.8)	48 (46.2)		**Reference**
ACT/CAT score	Controlled/low (n = 140)	92 (65.7)	48 (34.3)	**17.092 (0.001)**	**2.73 (1.69–4.42)**
	Partially controlled/medium (n = 102)	56 (54.9)	46 (45.1)		**1.73 (1.04–2.89)**
	Uncontrolled/high/v. high (n = 143)	84 (58.7)	59 (41.3)		**Reference**
PFT	Mild (n = 93)	64 (68.8)	29 (31.2)	**13.063 (0.001)**	**2.65 (1.55–4.52)**
	Moderate(n = 127)	59 (46.5)	68 (53.5)		1.38 (0.87–2.2)
	Severe (n = 165)	75 (45.5)	90 (54.5)		**Reference**
Learnt technique from	Doctor (n = 51)	32 (62.7)	19 (37.3)	**12.196 (0.007)**	**3.61 (1.54–8.45)**
	Nurse (n = 76)	47 (61.8)	29 (38.2)		**3.47 (1.58–7.62)**
	Pharmacist (n = 214)	114 (53.3)	100 (46.7)		**2.44 (1.23–4.87)**
	Non-medical personnel (n=44)	14 (31.8)	30 (68.2)		**Reference**

Categorical variables are represented as n (%). Chi^2 value (χ^2) was done to find the association of the variables with inhaler technique. The p value of < 0.05 was considered significant. The results were adjusted for false discovery rate with Benjamini-Hochberg correction. Odds ratio with 95% CI was done to find the degree of association. The significant results are highlighted. ACT — asthma control test; CAT — COPD assessment test; PFT — pulmonary function test

inspiratory effort with DPI use and uncontrolled disease [19].

Inhalation in the normal posture leads to impaction of drugs in the upper airways. Holding the chin in an upward posture brings airway to a stretched position, which helps to reduce the deposition of drugs in the oropharynx. The deposition of steroid and short-acting beta-2 agonist in the oropharynx leads to the development of oral thrush, caries, tremors, palpitations, and halitosis [20]. This was found to be one of the 12 most common errors recorded with the use of DPI in the inhaler technique assessment in the initiative Helping Asthma in Real-life Patients (iHARP) study [21].

Gargling or mouth rinsing after the inhaler use helps to remove the drug deposited in the mouth and oropharynx, and, in turn, to reduce the local and systemic side effects of the drugs [6]. Drinking water after inhalation increases the incidence of local and systemic side effects. Our study showed that only 12.5% of patients rinsed their mouth after inhalation. A meta-analysis done by Rachelefsky *et al*. revealed that oral thrush was three-fold higher in patients using DPI and not rinsing the mouth after inhaler use [22]. Samec *et al*. reported that asthmatic children who rinsed their mouth had less incidence of caries [23].

Table 5. Multiple logistic regression of patient-related and disease-related variables

Variable	Adjusted OR	95% CI
Age		
14–30 (n = 44)	**4.83**	**1.31–17.8**
31–50 (n = 147)	1.12	0.48–2.64
51–70 (n = 163)	0.77	0.34–1.76
70+ (n = 31)	**Reference**	
Place of living		
Rural (n = 300)	**Reference**	
Urban (n = 85)	1.61	0.94–2.76
Educational qualification		
NFE (n = 184)	**Reference**	
1–5 yrs (n = 99)	0.81	0.48–1.36
6–12 yrs (n = 76)	0.77	0.39–1.49
Graduate (n = 26)	0.95	0.30–2.98
Disease		
Asthma (n = 289)	0.95	0.54–1.66
COPD (n = 96)	**Reference**	
ACT/CAT score		
Controlled/low (n = 140)	**2**	**1.1–3.65**
Partially controlled / medium (n = 102)	1.53	0.87–2.71
Uncontrolled/High/V. high (n = 143)	**Reference**	
PFT		
Mild (n = 93)	1.6	0.87–2.94
Moderate (n = 127)	0.98	0.59–1.64
Severe (n=165)	**Reference**	
Learnt technique from		
Doctor (n = 51)	**3.67**	**1.46–9.24**
Nurse (n = 76)	**2.91**	**1.25–6.79**
Pharmacist (n = 214)	**2.60**	**1.23–5.51**
Non-medical personnel (n=44)	**Reference**	

The significant results are highlighted.
ACT — asthma control test; CAT — COPD assessment test; PFT — pulmonary function test.

Our study has shown an association of the inhaler technique with education, which has been echoed in various parts of the world in many previous studies [24]. This is attributed to the patients' inability to read the instruction sheet and understand the correct use of an inhaler. In a tertiary care hospital where the patient load is heavy, the health care professionals do not have adequate time to assess the patient's inhaler technique during their follow-up visits. Press *et al.* had proved that interventions to teach the inhaler technique resulted in better improvement in the inhaler technique in low literacy patients [25]**.** Hence the assessment of the patient's inhaler technique during their follow- up visit would be productive.

Majority of the population (n = 300) reside in a rural area, which is associated with biomass fuel use. This could be the reason for uncontrolled disease in patients residing in rural areas. A similar result is seen in Nigeria, where better inhaler technique among the urban population compared to the rural population has been shown [26].

Asthma patients have better disease control compared to COPD patients. The possible reason behind this is that COPD patients are diagnosed at a much older age and are unable to generate the inhalational force required for DPI for appropriate dose delivery. Studies conducted in India and also in other parts of the world did not show any significant association with the type of disease [7, 8]. A Brazilian study has found a significant connection between disease and the inhaler technique [27].

Patients with good control of disease assessed with both the questionnaire and spirometry had a good inhaler technique. This is understood by the fact that better drug delivery to the lungs leads to good disease control. This association between disease severity and the inhaler technique has been established in many studies [28, 29]. Acute attacks and hospital admissions were more frequent in patients who made at least > 1 serious inhaler error [17]. Whereas our study did not show any association with a number of acute attacks and hospital admissions.

Patients who learned the inhaler technique from healthcare professionals like doctors, nurses and pharmacists had better inhaler technique compared to those who learned it from a non-medical person like their friends, relatives or co-patients. The patients receive inhaler technique instructions only during their initial visit when they were first prescribed the inhaler. Some newly-diagnosed asthma patients might not obtain inhaler instructions from the healthcare professionals, and so they seek the help of others. A similar study reported that patients who received instruction from a pulmonologist had a good inhaler technique [26].

Multiple logistic regression revealed age, severity — assessed using a questionnaire — and the person as to who taught the inhaler technique were all associated with the inhaler technique even after adjusting for other factors like education, place of living, disease and PFT. A recent study from India also revealed a similar result

where multiple logistic regression showed that education and uncontrolled asthma were associated with the inhaler technique [9]. A Portuguese study disclosed the association with age and education to be related to the inhaler technique after adjusting for other variables like gender and an inhaler device [30].

Our study was strong enough to predict the factors associated with the incorrect use of an inhaler. The limitation of the study is that steps like keeping the chin up during inhalation and gargling after inhalation were assessed, but the incidence of side effects of the inhaler use like cough, dysphonia, hoarseness, change of taste and oral candidiasis with the use of steroids were not evaluated. The inhaler technique alone might not be the only reason for the poor disease control. Their lifestyle plays a significant role, which includes constant exposure to allergens through working in fields and in using biomass fuel. Adherence to inhaled medicines was not assessed, which also has a significant bearing on disease control.

Conclusions

This study has shown that the proper use of an inhaler is still an unattained goal in the population of bronchial asthma and COPD patients. Age, education, place of living, disease, the severity of disease and the person from whom the patient learned the inhaler technique are associated with improper inhaler use. Prescribing and providing drugs for the disease alone does not ensure disease control. Medical personnel have to ascertain the appropriate use of these drugs. The significance of the correct use of an inhaler has to be reiterated to the patients.

Conflict of interest

The authors have no conflicts of interest associated with the material present in this paper.

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