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Evaluation of Gender Differences of Inhalers Use and Training Needs among Chronic Obstructive Pulmonary Disease Patients in a Tertiary Care Hospital in Pakistan

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ABSTRACT

Background: Correct use of metered dose inhalers (MDIs) with spacers is crucial in the management of Chronic Obstructive Pulmonary Disease (COPD). Gender-based disparities in inhaler technique may influence treatment outcomes, particularly in low-resource settings.

Objective: To compare metered dose inhaler technique and training needs between male and female COPD patients.

Methodology: This descriptive cross-sectional study was conducted at the Pulmonology Unit, Khyber Teaching Hospital, Peshawar. A total of 140 COPD patients using MDIs with spacers were evaluated using a 9-step checklist. Patients were classified into proper, improper, or poor technique categories. Step-wise performance and receipt of prior guidance were assessed by gender. Chi-square tests were used to evaluate associations.

Results: Out of 78 male and 62 female patients, proper technique was observed in 17.9% males and 16.1% females. Not-Poor technique was more frequent among females (83.9%) than males (28.2%). Although 94.3% of patients reported receiving guidance, female patients missed more critical steps (especially steps 2, 3, and 4). Gender had no statistically significant association with overall technique category ($p = 0.216$), but significant differences were noted in specific step performances.

Conclusion: While overall technique did not differ significantly between genders, step-wise analysis reveals areas where female patients require enhanced training. Culturally sensitive and gender-focused educational strategies are recommended to optimize inhaler use and disease outcomes.

Keywords: COPD; MDI; Spacer; Gender Differences; Inhaler Technique; Pakistan

Introduction

Chronic Obstructive Pulmonary Disease (COPD) stands as a formidable global health challenge, representing a leading cause of morbidity and mortality worldwide, characterized by persistent respiratory symptoms and airflow limitation.[1] COPD continues to place a significant health and economic burden on low- and middle-income countries, including Pakistan, where delayed diagnosis, limited access to care, and suboptimal treatment practices remain common.[1,2] The disease imposes a crushing load on individuals, families, and the already strained healthcare system, leading to frequent hospitalizations, catastrophic health expenditures, and profound losses in quality of life and productivity.[3]

The cornerstone of managing stable COPD and preventing exacerbations lies in the long-term use of inhaled medications which include bronchodilators and corticosteroids. These therapies use devices that include Pressurized Metered-Dose Inhalers (pMDIs) and Dry Powder Inhalers (DPIs) and Soft Mist Inhalers (SMIs) to deliver medication which provides direct lung treatment that achieves optimal therapeutic results through minimal systemic side effects.[4,5] However, the efficacy of these life-saving treatments is critically dependent on one factor: correct inhaler technique. Despite the simplicity of MDIs, incorrect technique remains widespread. Numerous studies have reported that more than half of COPD patients commit critical errors that reduce lung deposition of the drug and compromise disease control.[6-8] These problems are heightened in resource-limited settings, where structured training and regular reinforcement are often lacking. Emerging evidence also suggests that gender-related factors, including variations in health literacy, social roles, physical limitations, and access to formal training may influence inhaler proficiency. Such disparities are particularly relevant in rural and semi-urban regions of Pakistan, where women frequently have fewer opportunities for health education and clinical counselling.

The existing gender differences within Pakistan's patriarchal society experience heightened effects because of its strict gender role conventions. Women residing in rural areas and belonging to lower socioeconomic groups have restricted access to education which prevents them from acquiring basic literacy skills and limits their ability to move freely while making healthcare choices.[9] Men have more restricted access to specialized tertiary care services which provide the highest quality training programs for their medical needs. Social stigma about chronic diseases limits men from seeking medical help until their health condition reaches a severe stage. The way healthcare providers interact with patients establishes a gender-based dynamic where providers take different approaches to teaching male and female patients because they believe both genders have distinct levels of medical knowledge.[10,11] The current situation establishes a framework which prevents equal assessment of inhaler training results.

The correct use of inhalers requires training and proper understanding but people in Pakistan still lack essential knowledge about these two things. Existing Pakistani studies about inhaler mistakes in COPD and asthma research present the patient group as a single entity which results in researchers failing to divide their data according to gender to study differences in technique mastery and error types and perceived training requirements. Researchers face a research gap because they have not studied how deep-rooted gender norms in society affect the practical aspects of treating patients who need device-based treatment for chronic respiratory illnesses. Does the gender of a COPD patient in a Pakistani tertiary care setting influence their likelihood of receiving adequate inhaler training? Are there detectable differences in the proficiency of inhaler technique between male and female patients? Do their perceived needs and barriers regarding inhaler use differ?

Recognizing these gaps, the present study aimed to assess gender differences in the correct use of MDIs with spacers among COPD patients. Using a validated nine-step assessment checklist, we evaluated patient performance, identified specific areas requiring improvement, and explored their training needs. The findings are intended to guide the development of targeted educational interventions that can enhance inhaler technique and support better disease management in similar populations.

Objective

To compare metered dose inhaler technique and training needs between male and female COPD patients.

Methodology

This descriptive cross-sectional study was carried out in the Pulmonology Unit of Khyber Teaching Hospital, Peshawar, a tertiary-care teaching institution functioning under the Medical Teaching Institution (MTI) Act in Khyber Pakhtunkhwa, Pakistan. Data were collected over a six-month period from April 2022 to October 2022. A non-probability consecutive sampling approach was used, as the objective was to recruit all eligible and consenting COPD patients presenting during routine clinical care. This approach was selected to ensure adequate sample availability within the study timeframe; however, it may introduce selection bias, which is acknowledged as a methodological limitation.

Patients between 40 and 70 years of age with a confirmed diagnosis of COPD based on GOLD criteria and with

current or past experience of using a metered-dose inhaler (MDI) with a spacer were considered eligible. Individuals who had never used an MDI, were unable to perform the inhalation maneuver due to physical or cognitive limitations, or were experiencing an acute exacerbation or any severe comorbidity that could interfere with assessment were excluded.

To evaluate inhaler technique, a structured checklist consisting of nine performance steps was employed. The checklist was adapted from previously published and validated inhaler technique assessment tools developed for MDI-with-spacer devices.[8,12] Minor contextual modifications were made for local clinical use, without altering the core steps. For the purpose of categorization, patients were classified into three groups: proper technique (all nine steps performed correctly), improper technique (up to three errors while ensuring correct execution of critical steps related to preparation, actuation, and inhalation), and poor technique (four or more errors irrespective of critical step performance).

To ensure consistency of measurements, two pulmonology residents were trained in checklist administration prior to the study. Training involved supervised observations and practice assessments until full agreement was achieved. Inter-rater reliability was monitored by independently scoring 20% of randomly selected encounters, yielding high concordance; discrepancies were discussed and resolved to maintain uniform assessment standards. Assessors were blinded to the study hypothesis but not to the patients' gender, as blinding to gender was not feasible during direct observational assessment; however, assessors were instructed to strictly follow the standardized checklist to minimize observer bias.

Ethical approval for the study was obtained from the Institutional Ethics and Research Committee of Khyber Teaching Hospital prior to data collection. All eligible participants were informed about the study purpose, procedures, voluntariness of participation, potential risks, and confidentiality safeguards. Written informed consent was obtained from each patient before enrolment. Data were analyzed using SPSS version 22. Descriptive statistics were used to summarize demographic and clinical characteristics, and Chi-square tests were applied to examine gender-based differences in technique performance. A p-value ≤ 0.05 was taken as statistically significant.

Results

A total of 140 patients with COPD were assessed, comprising 78 males (55.7%) and 62 females (44.3%). There was no significant difference in mean age between male and female participants (60.1 ± 7.4 vs 59.8 ± 7.2 years; p=0.81).

Literacy status differed significantly by gender, with a higher proportion of literate males compared to females (62.0% vs 39.0%; Odds Ratios = 2.53; 95% CI = 1.27 – 5.03; p = 0.012). Male patients were 2.5 times more likely to be literate than female patients, a statistically significant difference.

Proper inhaler technique was observed in 14 (17.9%) of males and 10 (16.1%) of females, with no significant gender difference (Odds Ratios = 1.14; 95% CI = 0.47 – 2.76; p = 0.95). Male patients had slightly higher odds of demonstrating proper inhaler technique compared with females; however, this difference was not statistically significant (Table 1).

Most participants reported receiving prior instruction on inhaler use—91.0% of men (71/78) and 98.4% of women (61/62), difference approached but did not reach statistical significance (p = 0.062, difference: 7.4%; 95% CI: –0.3% to 14.6%). Despite high reported guidance, performance variability suggests inadequate retention or quality of instruction.

Performance varied considerably across the nine steps. Steps 3 and 4 showed the lowest adherence across both genders, indicating deficits in breathing preparation and mouthpiece sealing. Women underperformed in assembly-related steps, whereas men underperformed in timing and breath-holding steps. Step 5 was the only step showing a significant gender difference, with females performing slightly better (p-value 0.03). None of these differences remained significant after correction. The complete step-wise distribution is presented in Table 2.

The study collected data on age and literacy; however, COPD severity was not recorded, limiting the ability to adjust for clinical variability. Because only two confounders were available, and the sample size was modest, a multivariate regression model was deemed

Table 1. Proper Technique vs. Not-Proper Technique by Gender

Gender	Proper	Not-Proper	Total	Odds Ratio	95% CI	P-value
Male	14 (17.9%)	64 (82.1%)	78	1.14	0.47 – 2.76	0.954
Female	10 (16.1%)	52 (83.9%)	116			
Total	24	116	140			

statistically underpowered. Instead, stratified analyses (e.g., literacy stratification) were performed.

To evaluate independent predictors of proper technique, a logistic regression model was constructed including: gender, age, literacy status, prior guidance, and disease duration (<5 years vs. ≥5 years). Key Findings (Adjusted ORs) shown in Table 3.

Literacy showed a markedly positive association with technique accuracy. Participants with the ability to read and write (n = 87) demonstrated significantly better technique compared with those who were illiterate (n = 53). Among literate participants, 23% achieved proper technique, compared to only 8% among illiterate patients (absolute difference: 15%; 95% CI: 4.2% to 27.6%, p = 0.018). No statistically significant interaction was found between literacy and gender (p = 0.76), suggesting literacy independently influenced inhaler proficiency.

Only literacy remained a significant independent predictor of proper technique. Gender did not retain any independent predictive value after controlling for confounders.

Discussion

This study highlights substantial deficiencies in MDI-spacer technique among COPD patients, with women demonstrating comparatively lower performance on several critical steps. These findings mirror international

Table 2. Step-wise Performance

Step No.	Gender	Yes	No	p-value	Observation
Shake device	Male (n=78)	72	6	0.40	High compliance both genders
	Female (n=62)	60	2		
Attach spacer	Male (n=78)	72	6	0.21	Females missed more
	Female (n=62)	54	8		
Exhale gently before use	Male (n=78)	22	56	0.47	Low performance overall
	Female (n=62)	14	48		
Seal lips tightly around mouthpiece	Male (n=78)	36	42	0.47	Modest female deficit
	Female (n=62)	25	37		
Actuate inhaler while inhaling	Male (n=78)	72	6	0.03	Females slightly better
	Female (n=62)	62	0		
Inhale slowly & deeply	Male (n=78)	65	13	0.38	Similar across gender
	Female (n=62)	55	7		
Hold breath 5–10 s post-inhalation	Male (n=78)	43	35	0.16	Slight female advantage
	Female (n=62)	41	21		
Wait before a second puff	Male (n=78)	40	38	0.28	Non-significant disparity
	Female (n=62)	37	25		
Exhale slowly after inhalation	Male (n=78)	39	39	1.00	Identical but retention questionable
	Female (n=62)	31	31		

Table 3. Key Findings (Adjusted Ors)

Variable	Adjusted OR	95% CI	p-value
Female gender	1.09	0.41–2.89	0.86
Literate vs. illiterate	3.28	1.22–8.84	0.018
Age (per 1-year increase)	0.97	0.92–1.03	0.31
Prior training received	1.42	0.26–7.71	0.67
Disease duration ≥5 years	1.33	0.53–3.30	0.53

evidence showing that 60–80% of inhaler users commit at least one major error despite receiving instructions.[12-15] Our results are also aligned with studies from South Asia and the Middle East, where female patients particularly those with limited education show higher rates of inhaler misuse.[16,17]

A deeper examination of gender disparities suggests multiple contributing factors. First, several of the steps in MDI-spacer technique, such as coordinating actuation with inhalation, maintaining breath-hold, and ensuring proper seal require confidence, prior familiarity, and repeated practice. Different national and International studies indicate women often report lower exposure to device demonstrations, less opportunity for hands-on practice, and a tendency to rely on verbal instructions rather than physical demonstration. Second, literacy and health-literacy differences disproportionately affect women in rural Pakistan, which may limit comprehension of multi-step inhaler procedures. Similar findings have been reported in Pakistan, India, and Bangladesh, where educational status strongly predicts correct inhaler technique.[18-21]

Device-selection considerations further illuminate these disparities. Evidence shows that peak inspiratory flow (PIF) may be lower in older females, affecting the suitability of dry-powder inhalers (DPIs).[19-21] While MDIs with spacers reduce the dependence on PIF, proper technique remains essential. Several international trials demonstrate that matching inhaler type to the patient's inspiratory flow and manual dexterity improves outcomes.[22] Our findings reinforce the need for individualized device assessment, especially for women and older adults.

Although most participants reported receiving guidance on inhaler use, stepwise analysis revealed persistent errors. This gap between reported instruction and demonstrated skill is consistent with global literature, which attributes persistent errors to inadequate reinforcement, lack of structured follow-up, and minimal use of pictorial or practical teaching tools.[23,24] Interventions such as repeated demonstration, teach-back methods, simplified step-cards, and culturally contextualized messaging have been shown to significantly improve inhaler mastery.

Cultural sensitivity in training programs can be operationalized in several ways: 1) Gender-sensitive counseling: allocating female health workers or pharmacists to train female patients. 2) Use of culturally relatable visuals: locally designed pictorial guides showing step-by-step inhaler technique. 3) Family-inclusive education: training a family member (often influential in medication administration) to reinforce technique. 4) Community-based reinforcement through CHWs (lady health workers), particularly beneficial for rural women with restricted mobility. 5) Low-literacy adaptations, using color-coded arrows, icons, and minimal-text instruction cards.

Emerging practices such as pharmacy-led inhaler education, digital reminders, and video-based demonstrations also show promise. International studies affirm that digital adherence monitoring improves inhaler technique and overall disease control, particularly when combined with periodic in-person reviews.

Our findings therefore contribute to the growing evidence that gender, device characteristics, educational attainment, and cultural context interact significantly to influence inhaler technique. Addressing these factors is essential to improving COPD care in Pakistan.

Conclusion

This study demonstrates that incorrect MDI-spacer technique is highly prevalent among COPD patients, with women showing greater difficulty in performing several essential steps. These disparities appear to be influenced by educational status, limited opportunities for hands-on training, and possible physiological factors such as lower inspiratory flow in older females. To improve outcomes, inhaler training programs must adopt gender-sensitive, literacy-appropriate, and culturally grounded strategies. Repeated demonstrations using simplified visuals, teach-back methods, and periodic annual reviews should be incorporated into routine clinical practice. Device selection must also account for inspiratory-flow

differences and individual patient capability, ensuring that each patient receives the most suitable inhaler type. Looking ahead, large-scale implementation research is needed to evaluate the effectiveness of community-based inhaler training models, digital monitoring tools, and pharmacist-led interventions in Pakistan. Policymakers should also consider integrating standardized inhaler-training protocols into national COPD management guidelines. Strengthening patient education in these ways has the potential to improve technique, enhance adherence, and significantly reduce COPD morbidity in the Pakistani population.

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