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A CROSS SECTIONAL STUDY ON ASSESSMENT OF PROPER USAGE TECHNIQUES OF INHALATIONAL DEVICES AMONG PATIENTS WITH ASTHMA AND COPD IN A RURAL MEDICAL COLLEGE HOSPITAL

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Abstract

Introduction: Asthma and Chronic Obstructive Pulmonary Disease (COPD) are among the most prevalent chronic respiratory conditions worldwide, impacting millions and imposing a significant strain on healthcare systems. Asthma is marked by chronic airway inflammation, leading to variable and recurring symptoms, airflow obstruction, and heightened bronchial responsiveness. Conversely, COPD is a progressive disorder characterized by persistent airflow limitation and respiratory symptoms, mainly due to exposure to harmful particles or gases. Inhalation therapy remains the cornerstone of treatment for both asthma and COPD, as it enables the direct delivery of medication to the airways, providing swift symptom relief and reducing the likelihood of exacerbations.

Materials and Methods: The study was conducted at KVG Medical College and Hospital, Sullia, Dakshina Kannada District, India. The study was carried out over a period of 6 months, from September 2025 to February 2026. Patients aged more than 18 years, of both sexes, Patients diagnosed with Asthma and COPD were included in the study. Patients not willing to participate in the study, Patients with active respiratory infections were excluded from the study.

Results: The study aimed to evaluate the proper usage techniques of inhalational devices among patients with asthma and COPD. A total of 80 patients were included, with a mean age of 48.5 years (range: 18-78 years) and there was majority of males compare to females. (58.75% males vs. 41.25% females). In this study most of the participants (43.75%) resided in urban areas (Graph 2). In terms of education level, 23.75% had no formal education, while 26.25% had higher secondary education (Graph 3). The study also found that 27.5% of patients were employed, 20% were retired, 26.25% were students, and 26.25% were unemployed.

Conclusion: Various inhaler devices are currently accessible for administering inhaled medications to COPD patients. This field of inhaled drug delivery is dynamic, with numerous existing inhalers and frequent introductions of new ones. The abundance of inhaler devices

available, each requiring specific inhalation techniques for optimal drug delivery, may lead to confusion among both patients and healthcare providers, a phenomenon known as "device dementia". Nonetheless, there are several common steps or actions applicable to all types of devices discussed in this article. These steps are arguably the most crucial aspects of inhaler technique for teaching and learning how to use each device effectively, considering that most patients are likely to try multiple types of inhalers over their lifetime, making mastery of a new device easier.

Key Words: Asthma, Chronic Obstructive Pulmonary Disease, active respiratory infections.

INTRODUCTION

Asthma and Chronic Obstructive Pulmonary Disease (COPD) are among the most prevalent chronic respiratory conditions worldwide, impacting millions and imposing a significant strain on healthcare systems. Asthma is marked by chronic airway inflammation, leading to variable and recurring symptoms, airflow obstruction, and heightened bronchial responsiveness. Conversely, COPD is a progressive disorder characterized by persistent airflow limitation and respiratory symptoms, mainly due to exposure to harmful particles or gases. Inhalation therapy remains the cornerstone of treatment for both asthma and COPD, as it enables the direct delivery of medication to the airways, providing swift symptom relief and reducing the likelihood of exacerbations.[1]

Inhaled medications can be delivered using various devices such as pressurized metered-dose inhalers (pMDIs), dry powder inhalers (DPIs), and nebulizers. The success of inhalation therapy heavily relies on the patient's ability to use these devices correctly. Proper inhaler technique is vital for effective drug delivery to the lungs, and incorrect usage can result in diminished drug deposition, inadequate symptom control, and a higher risk of exacerbations. Studies have shown that the rate of incorrect inhaler use among asthma and COPD patients ranges from 14% to 90%.[2]

Several factors contribute to improper inhaler use, including insufficient patient education, inadequate instructions from healthcare providers, and the complexity of inhaler devices. Additionally, a patient's age, education level, and socioeconomic status are linked to incorrect inhaler use. Therefore, regularly assessing and correcting patients' inhaler techniques is crucial for optimizing treatment outcomes and alleviating the burden of asthma and COPD.[3]

In rural areas, access to healthcare services and patient education can be limited, which may lead to a higher prevalence of incorrect inhaler techniques. Rural populations often encounter challenges such as lower socioeconomic status, limited health literacy, and reduced access to specialized care, all of which can negatively affect their ability to manage chronic respiratory diseases effectively. Assessing the proper use of inhalation devices among asthma and COPD patients in rural settings is essential to identify gaps in patient education and develop targeted interventions to improve inhaler technique and disease management.[4]

The prevalence of asthma and COPD in rural populations is increasingly concerning. Research indicates that asthma prevalence in rural areas is comparable to, and sometimes higher than, that in urban areas. Similarly, COPD is a significant issue in rural communities, with higher rates among rural residents compared to urban dwellers. This increased prevalence may be due to factors such

as exposure to environmental pollutants, occupational hazards, and limited access to preventive care and education.[5]

Proper inhaler technique is critical for effectively managing asthma and COPD. Incorrect inhaler use can lead to suboptimal drug delivery, reduced medication efficacy, and poor disease control. Studies show that patients with poor inhaler technique are more likely to experience symptoms, exacerbations, and a reduced quality of life compared to those who use their inhalers correctly. Additionally, incorrect inhaler use can result in increased healthcare utilization and costs, as patients may need more frequent emergency department visits and hospitalizations due to uncontrolled symptoms.

AIMS AND OBJECTIVES

1. Assessment of Proper usage techniques of Inhalational devices among patients with asthma and COPD.

2. To evaluate the impact of non-adherence to inhalational techniques and inhalational drug on exacerbation in patient with Asthma and COPD.

MATERIALS AND METHODS

Materials:

Study Setting: The study was conducted at KVG Medical College and Hospital, Sullia, Dakshina Kannada District, India.

Study Design: This was a cross-sectional study.

The study was carried out over a period of 6 months, from September 2025 to February 2026.

Study Population: The study population consisted of patients diagnosed with COPD and Asthma attending KVG Medical College and Hospital, Sullia, as outpatients or inpatients.

Sample Size Calculation: The sample size was calculated based on the prevalence of COPD in India according to the Global Burden of Disease study, which was 4.4%. Using this prevalence "p" and substituting it in the formula $4pq/L^2$, where L is the allowable error (5%) and q is (100-p), the minimum sample size was estimated to be 67.3. Therefore, the sample size for this study was taken as 80.

Inclusion Criteria:

- Patients aged more than 18 years, of both sexes.
- Patients diagnosed with Asthma and COPD.

Exclusion Criteria:

- Patients not willing to participate in the study.
- Patients with active respiratory infections.

Sampling Method: Systematic random sampling was employed, where every third patient was included in the study.

Methodology of Data Collection:

Informed Consent and History Taking: Informed written consent was obtained from all participants. A detailed history of Bronchial asthma and COPD patients was taken, including information on the duration of the disease, symptoms, and previous treatments. Systemic physical examinations and respiratory examinations were performed on all participants to assess their general health status and respiratory function.

Assessment of Inhalational Devices and Technique: The type of inhalational devices used by the patients, such as Dry Powder Inhalers (DPIs) and Metered-Dose Inhalers (MDIs), was recorded. The inhalation method and adher0ence to the prescribed drug regimen were assessed using a standardized checklist based on the working definition of the steps followed during the usage of DPIs and MDIs.

Assessment of Disease Control: The COPD Assessment Test (CAT) score and Asthma Control Test (ACT) score were used to evaluate the outcome of patients with proper inhalation technique. These scores provided an objective measure of disease control and quality of life in patients with COPD and Asthma, respectively.

Data Collection: Data were collected using a structured questionnaire that included demographic information, disease history, type of inhalational device, inhalation technique, adherence to medication, and disease control scores (CAT and ACT). The questionnaire was administered through face-to-face interviews with the participants.

Quality Control: To ensure the quality of data collection, the researchers were trained in the proper administration of the questionnaire and assessment of inhalation technique. Regular monitoring and supervision were carried out to maintain consistency and accuracy in data collection.

Data Analysis: The collected data were entered into a Microsoft Excel spreadsheet and analyzed using appropriate statistical software. Descriptive statistics, such as frequencies, percentages, means, and standard deviations, were used to summarize the data. Inferential statistics, such as chi-square tests and t-tests, were employed to examine the associations between variables and compare groups.

Ethical Considerations: The study protocol was approved by the Institutional Ethics Committee of KVG Medical College and Hospital, Sullia. All participants provided informed written consent, and their confidentiality was maintained throughout the study. The study adhered to the principles of the Declaration of Helsinki.

RESULTS

The study aimed to evaluate the proper usage techniques of inhalational devices among patients with asthma and COPD. A total of 80 patients were included, with a mean age of 48.5 years (range: 18-78 years) and there was majority of males compare to females. (58.75% males vs. 41.25% females) (Graph 1). In this study most of the participants (43.75%) resided in urban areas (Graph 2). In terms of education level, 23.75% had no formal education, while 26.25% had higher secondary education (Graph 3). The study also found that 27.5% of patients were employed, 20% were retired, 26.25% were students, and 26.25% were unemployed (Graph 4).

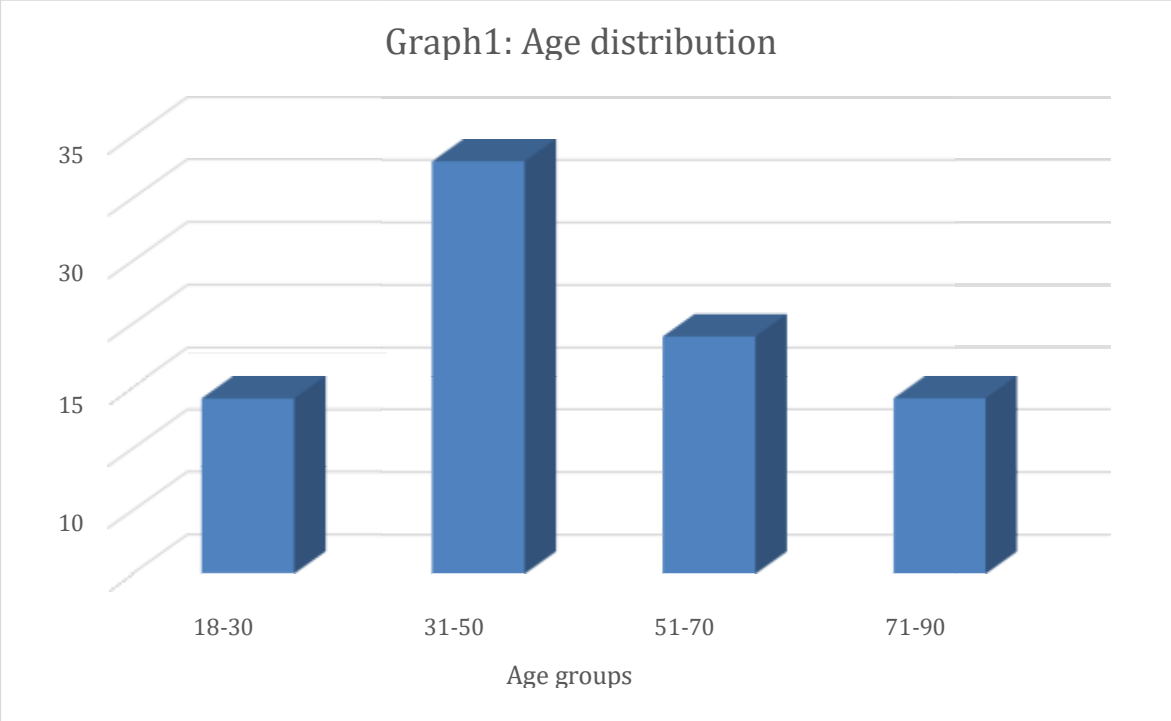
Table 1: Demographic details of the patients.

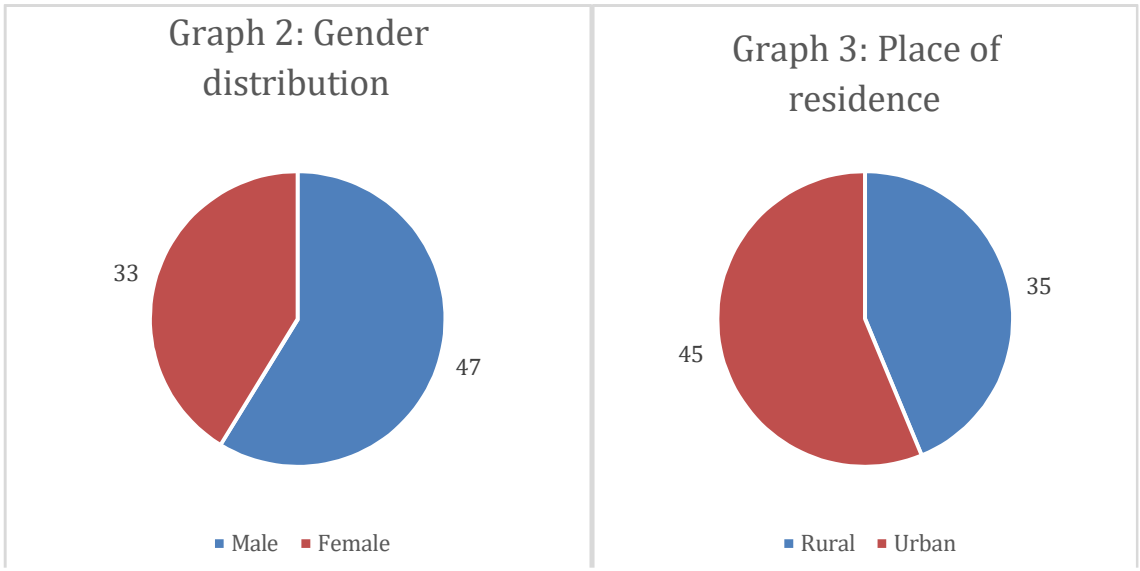
Variable of assessment	Categories	Frequencies	Percentage (%)
Gender	Male	47	58.75
	Female	33	41.25
Place of Residence	Rural	35	43.75
	Urban	45	56.25
Education level	No formal education	19	23.75
	Primary	17	21.25
	Secondary	23	28.75
	Higher	21	26.25
Occupation	Employed	22	27.5
	Unemployed	21	26.25
	Retired	16	20
	Student	21	26.25

Table 2: Gender distribution

Age groups	Frequencies	Percentage (%)

18-30	14	17.5
31-50	33	41.25
51-70	19	23.75
71-90	14	17.5





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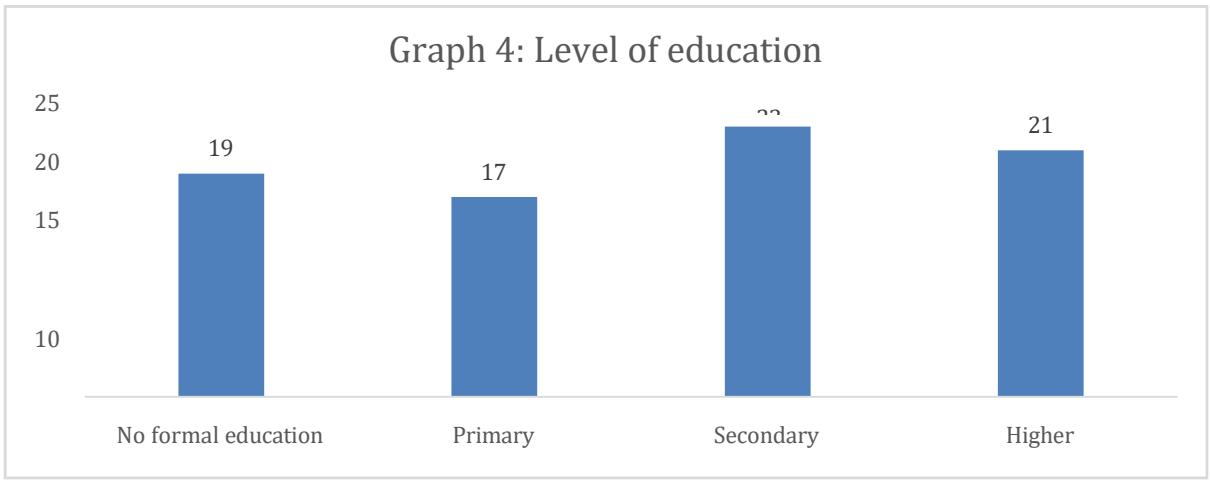
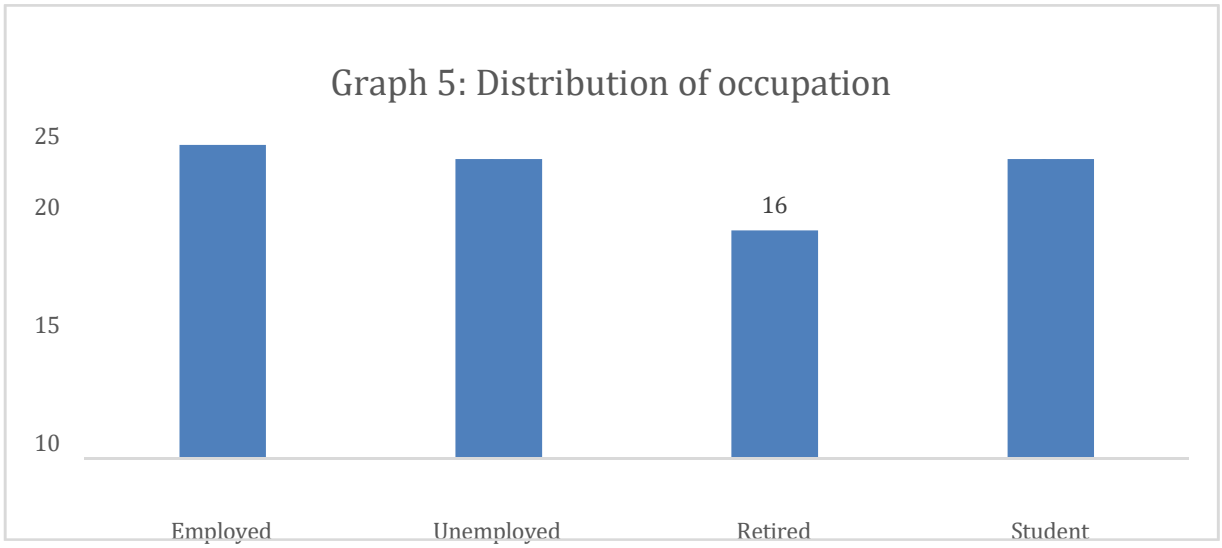


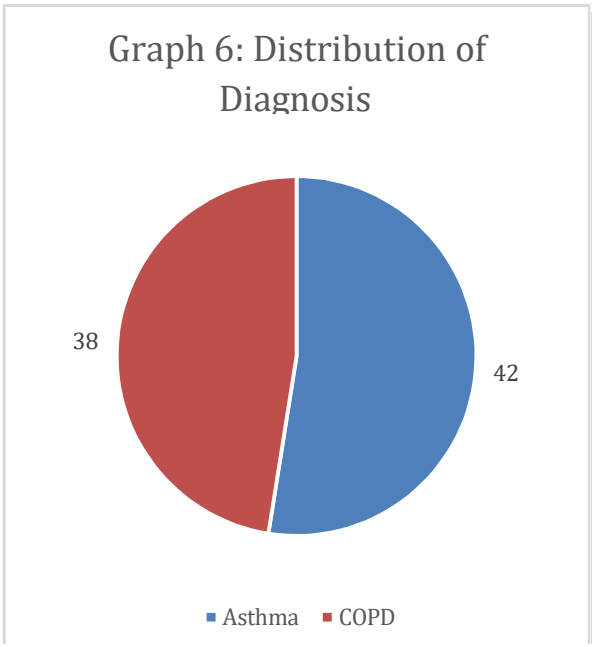


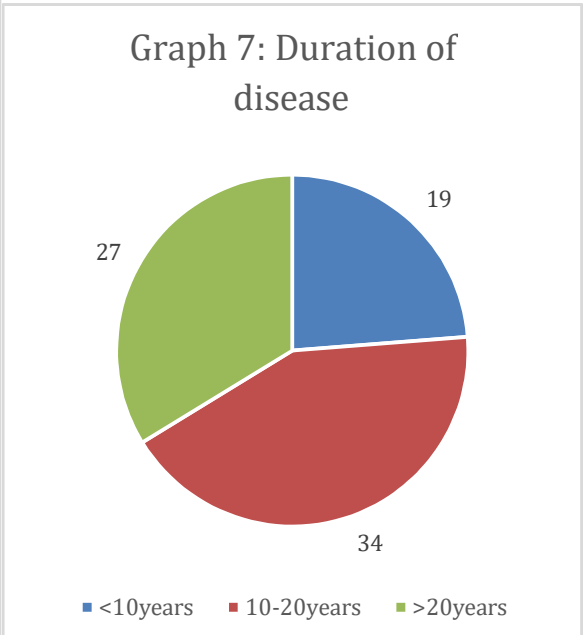
Description of the disease course:

On characterizing the diagnosis, we found that 42 patients were having asthma while the rest were diagnosed as a case of COPD (Graph6). On enquiry, 19(23.75%) had the disease for <10 years, 34 (42.5%) had the disease course 10-20 years (graph 7). In 27 patients, the diagnosis of the disease was made more than 20 years back. Among the 80 patients included, 38 patients gave a positive history of smoking, while the rest denied (Graph 8). On a detailed systemic examination, abnormal findings were noted in 43 patients, while in 37 patients it was normal.

Table 3: Baseline characteristics of the patients

Variable	Categories	Frequency	Percentage (%)
Diagnosis	Asthma	42	52.5
	COPD	38	47.5
Duration of Disease	<10years	19	23.75
	10-20years	34	42.5
	>20years	27	33.75
History of Smoking	Yes	38	47.5
	No	42	52.5
Findings in respiratory system	Rhonchi/ wheeze	65	81.25
	Normal finding	15	18.75


Graph 6: Distribution of Diagnosis
38
42
Asthma
COPD


Graph 7: Duration of disease
19
27
34
<10years
10-20years
>20years

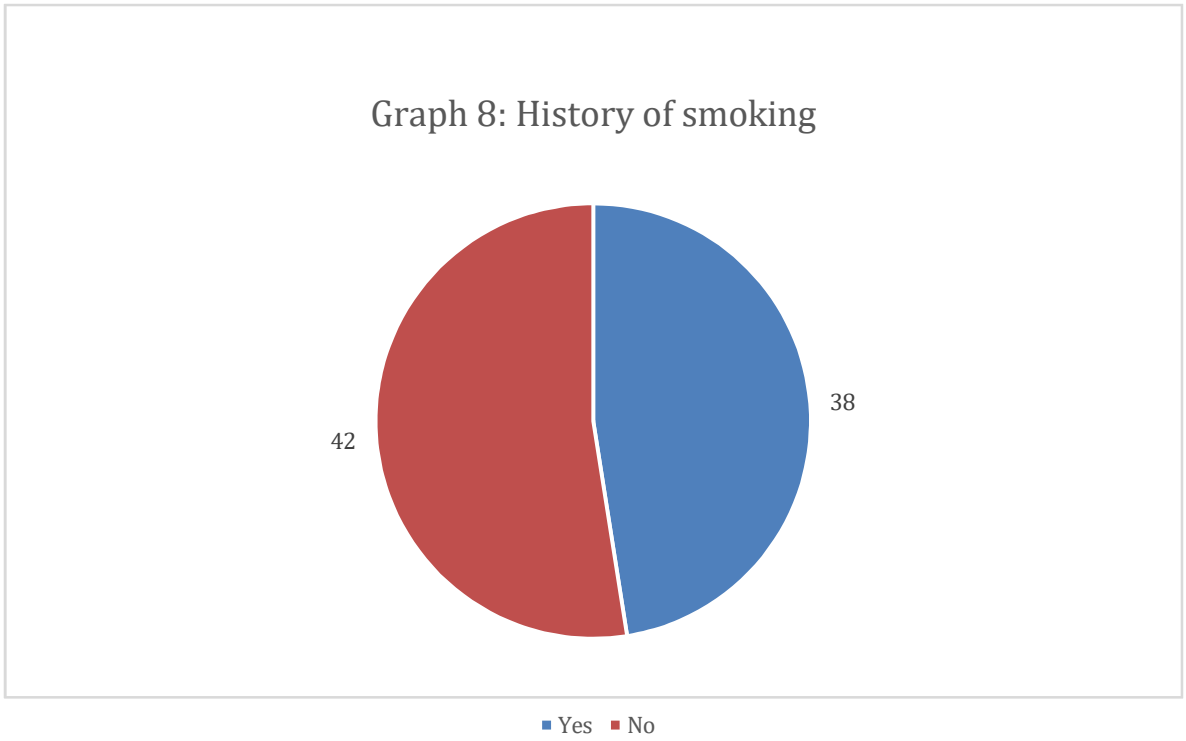

Graph 8: History of smoking
38
42
Yes
No

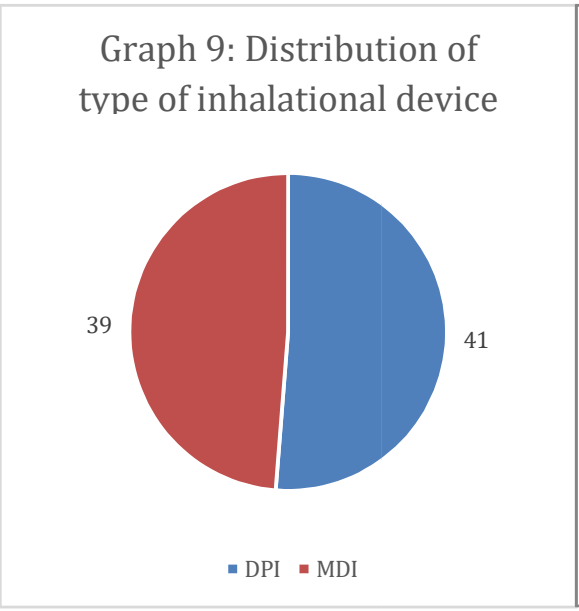
Table 4: Description of usage of device

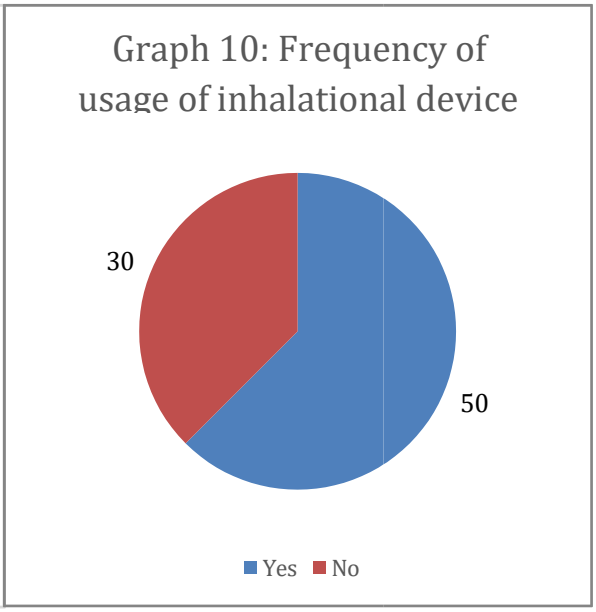
Variable	Categories	Frequency	Percentage (%)
Device type	DPI	41	51.25
	MDI	39	48.75
Frequency of usage	Daily	50	62.5
	As needed	30	37.5
Adherence	Yes	22	27.5
	No	58	72.5
Reasons for non-adherence	Forgetfulness	20	34.48
	Lack of understanding	38	65.5
Frequency of missed doses	Daily	10	12.5
	Weekly	17	21.25
	Monthly	10	12.5

Among the 80 patients, 41 patients used DPI while 39 used MDI. The majority patients used the device daily (30 patients, 37.5%) and 27 (33.75%) used the device once a week. 23 patients used the device when needed.

The adherence level was assessed, and it was noted that 22 patients correctly adhered to the usage. The most common reasons for non-adherence included lack of understanding (38 patients), forgetfulness (20 patients).

On enquiry of frequency of missed doses, 10 patients replied that they would miss the dose Once in a day, 17 patients replied to the dose would be missed once a week, while another 10 Patients told that missed dose was noted only once a month.





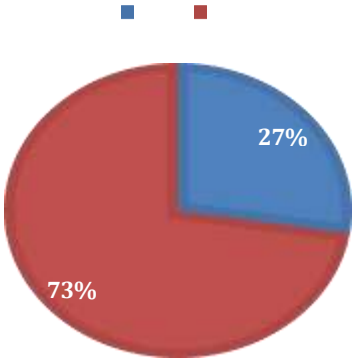


Table 5: Distribution of hospitalization due to exacerbations/worsening of the condition

Variable	Adherence to inhalation techniques N (%)	Non-adherence to inhalation techniques N (%)
Hospitalizations due to exacerbations/worsening of		
The condition (N=66, 82.5%)		
	14(17.5)	52(65.5)

It was seen that 66, (82.5%) patients were hospitalized in view of acute exacerbation. The average number of Exacerbations in past year was 4.63 ± 3.03 times with a median [IQR] of 5[1.25-7.75] times.

ACT score:

5 items were assessed in ACT score and an overall score was also assessed. This included activity limitation, shortness of breath, symptoms at night, rescue inhaler use, asthma control self-rating.

Table 6: Mean of ACT score

Variable of assessment	Observation (Mean±SD)
Activity limitation	2.85± 1.3
Shortness of breath	2.83± 1.3
Symptoms at night	3 ±1.3
Rescue inhaler use	2.92± 1.4
Asthma control self-rating	3.27±1.33
ACT score (Overall)	**14.88±2.97**

CAT score:

8 items were assessed in ACT score and an overall score was also assessed. This included frequency of cough, Amount of Phlegm, Chest Tightness, Breathlessness with Activity, Limitation in Activities, Confidence Leaving Home, Quality of Sleep, Energy Levels. No statistical difference noted among the two groups; hence CAT score was comparable among the two groups (p=0.17 on unpaired T test).

Table 7: Mean of CAT score

Variable of assessment	Observation (Mean±SD)
Frequency of cough	2.66± 1.7
Amount of Phlegm	2.13± 1.6
Chest Tightness	2.46±1.66
Breathlessness with Activity	2.48± 1.7

Limitation in Activities	2.77± 1.7
Confidence Leaving Home	2.57± 1.7
Quality of sleep	2.43± 1.8
Energy levels	2.48± 1.7
CAT score (Overall)	**20.02±4.7**

Table 8: Errors during MDI usage

Steps for usage of MDI	**Frequency**	**Percentage (%)**
Remove cap	0	0
Shake the inhaler	2	5.13
Lock the lips appropriately around the mouth piece	2	5.13
Exhale fully	27	69.23
Hold the MDI properly	3	7.69
Inhale as soon as canister is pressed	2	5.13
Taking a deep breath slowly and deeply	7	17.95
Hold the inhaled air for 5-10 seconds	20	51.28
Re-shake the inhaler for second puff	7	17.95
Rinse well after inhalation	16	41.03

Table 9: Errors during DPI usage

Steps for usage of DPI	**Frequency**	**Percentage (%)**
Remove cap	0	0

Load a dose of medicine	0	0
Close the mouth piece firmly	0	0
Exhale fully	28	68.29
Sit/stand up right, and breathe deeply as you can	14	34.15
When done correctly, a vibration sound is heard	0	0
Hold the inhaled air for 5-10 seconds	23	56.1
After the use discard rota caps	3	7.32
Wait about 1 minute before next dose	4	9.76
Rinse well after inhalation	18	43.9

Many patients make mistakes when using their inhalers, which can reduce the medication's effectiveness and lead to complications. It revealed that a significant number of patients made errors when using their inhalers. The most common mistake was exhale fully before inhaling medication. The second most frequent error was patients did not hold their breath for the recommended 5-10 seconds after inhaling, potentially reducing the effectiveness of the medication. The third most common error was inadequate rinsing of the mouth after inhalation, which can lead to oral thrush and other complications.

Table 10: Impact of type of device on the proper usage and adherence:

Variable	DPI	MDI	P-value(Chi-square test)
Adherence to inhalation techniques	13	9	0.038*
Non-adherence to inhalation techniques	28	30	

There is a statistical association of impact of device type on the patient adherence and usage technique was noted, $p<0.05$ on Chi-square test.

Table 11: Impact of adherence on symptom worsening based on hospitalizations

Variable	Adherence	Non adherence	P-value(Chi-square test)
Hospitalization	14	52	0.043*
No hospitalization	8	6	0.079

The study revealed a statistically significant association between hospitalization rates and adherence to proper inhalation techniques, with a p-value of 0.043. This indicates that a significant proportion of hospitalizations were attributed to non-adherence to correct inhaler use. The reasons for this association may include:

- Inadequate medication delivery to the lungs, leading to poor disease control and increased risk of exacerbations.

- Increased risk of medication side effects due to incorrect technique.
- Reduced efficacy of treatment, resulting in more severe symptoms and increased need for hospitalization.

- Lack of patient education and training on proper inhaler technique, leading to misunderstandings and mistakes.

Overall, the findings suggest that non-adherence to proper inhalation techniques is a significant predictor of hospitalization, highlighting the importance of patient education and training to improve disease management and reduce healthcare utilization.

DISCUSSION

Asthma is chronic disease characterized by recurrent episodes of breathlessness and wheezing affecting almost 339 million people worldwide and causing approximately 1000 daily deaths, according to Global asthma report 2018. The Chronic obstructive pulmonary disease (COPD) is an umbrella term used to describe progressive respiratory conditions like Emphysema and chronic bronchitis. Inhalation therapy is the primary treatment approach for these respiratory diseases, with inhalers serving as the key delivery devices for medications. However, the effectiveness of inhalers can be impacted by various factors, including the patient's age, gender, educational background, type of inhaler used, and proper usage techniques. Correct inhalation technique is needed for active management of disease like Asthma and COPD since improper use of inhalers may results in diminished therapeutic effect, resulting in poor control of symptoms and thereby leading to improper disease management . The technical features of

inhalers have improved constantly, but the delivery of the drug to the lungs depends upon correctly executed inhalation technique.[6]

However, non-adherence to prescribed inhalational techniques and medication regimens poses a significant barrier to effective disease control. This thesis aims to investigate the impact of non-adherence on exacerbation rates in patients with asthma and COPD, exploring the complex relationships between inhaler technique, medication adherence, and disease outcomes. By examining the consequences of non-adherence, this study seeks to inform strategies for improving patient education, inhaler technique, and adherence, ultimately reducing exacerbation rates and enhancing quality of life for individuals with asthma and COPD.[7]

Defining treatment adherence is a complex challenge. At its core, adherence refers to the extent to which patients follow their prescribed medical regimen. However, various factors can impact medication adherence, including the delivery method, dosing schedule, palatability, therapeutic response, and potential side effects. For instance, taking a single oral medication might be simpler and more manageable for patients than adhering to a treatment plan involving multiple pills with varying frequencies, highlighting the need for a nuanced understanding of adherence.[8]

Numerous studies have suggested that patients adhere to inhaled drug therapy less than to orally administered therapies. A study done by Mika J Mäkelä et al. shows that adhering to inhaled medications for asthma and COPD leads to better symptom control, improved lung function, and increased patient satisfaction. Good adherence also reduces healthcare costs and usage, especially for severe cases. However, non-adherence results in higher costs, more healthcare usage, and a decreased quality of life. To address these issues, it's essential to develop strategies that improve patient adherence to inhaled therapies.

In our study, only 22 patients (27.5%) demonstrated correct adherence to their prescribed inhaler usage. The most common reasons for non-adherence in our study were lack of understanding (65.5%) and forgetfulness (34.48%). These findings are consistent with a study by Jacqueline O'Tooleet al. which identified similar barriers to adherence, including lack of knowledge, cost, and forgetfulness. Challenges with adherence reported were gaps in understanding, forgetfulness of the patient, physician availability, cost navigation, and overcoming substance use.[9]

Regarding the frequency of missed doses, our study found that 10 patients replied that they would miss the dose once in a day, 17 patients replied to the dose would be missed once a week, while another 10 patients told that missed dose was noted only once a month. A study Gen Tamura et al done by the most common reason for poor adherence was "frequency of administration", and 83.2% of the patients preferred a once-daily administration.[10]

CONCLUSION

Various inhaler devices are currently accessible for administering inhaled medications to COPD patients. This field of inhaled drug delivery is dynamic, with numerous existing inhalers and frequent introductions of new ones. The abundance of inhaler devices available, each requiring specific inhalation techniques for optimal drug delivery, may lead to confusion among both patients and healthcare providers, a phenomenon known as "device dementia". Nonetheless, there are several common steps or actions applicable to all types of devices discussed in this article. These steps are arguably the most crucial aspects of inhaler technique for teaching and learning how to use each device effectively, considering that most patients are likely to try multiple types of inhalers over their lifetime, making mastery of a new device easier.

The final step common to all devices is breath-holding. Studies focused on pMDI use indicate that holding the breath for 10 seconds results in greater lung deposition compared to holding it for 4 seconds, as the additional time allows for better sedimentation of the inhaled drug in the small airways of the lungs. Given that the particle size distribution of aerosols delivered by other devices discussed here closely resembles that of pMDIs, breath-holding is likely equally beneficial for patients using these devices as well.

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