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Role of Non-Invasive Ventilation in Respiratory Failure due to Poor Treatment Compliance in Chronic Obstructive Pulmonary Disease Patients

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Abstract

Objective: To determine the efficacy of non-invasive ventilation in respiratory failure due to poor treatment compliance in COPD patients. **Study Design:** Quasi experimental study. **Place and Duration of Study:** This study was carried out in the Department of Pulmonology at Medical Teaching Institution Hayatabad Medical Complex Peshawar from 25 July 2025 to 25 January 2026. **Methodology:** A total of 110 patients having age between 30 and 70 years with respiratory failure due to poor treatment compliance in chronic obstructive pulmonary disease were included. All patients were managed with non-invasive ventilation and arterial blood gas was repeated after 24 hours. Efficacy was noted. Data analysis was done using Statistical Package for Social Sciences version 25. Mean and standard deviation were calculated for numerical variables and frequencies with percentages for categorical variables. Chi-square test were applied for stratification. **Results:** Mean age of patients was 53.05 ± 10.06 years and mean body mass index was 28.22 ± 3.31 kilograms per square meter. There were 76(69.1%) males and 34(30.9%) females. Overall efficacy of non-invasive ventilation was observed in 66(60.0%) patients while 44(40.0%) patients did not show improvement. No significant association was found between efficacy and demographic factors including age, gender, body mass index, smoking, diabetes, hypertension, profession and previous

ventilation history (p>0.05). **Conclusion:** Non-invasive ventilation shows moderate effectiveness in management of respiratory failure among patients with chronic obstructive pulmonary disease who have poor treatment compliance.

Keywords: Chronic Obstructive Pulmonary Disease; Pulmonary Ventilation; Respiratory Insufficiency; Treatment Outcome

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common chronic respiratory disease that involves persistent airway limitation and dyspnea.[1] It is often caused by long-term exposure to noxious particles, including cigarette smoke, biomass fuel combustion, and environmental pollutants.[2] In patients with COPD, long-standing airway inflammation and damage to the lung parenchyma cause narrowing of the bronchial tubes and loss of elastic recoil within the lungs.[3] This compromises the flow of air during both inspiratory and expiratory phases, resulting in symptoms like coughing, expectoration of sputum, and increasingly severe shortness of breath.[4] This is a slowly progressive disease that often involves a series of relapses that worsen the patient's pulmonary status and increases their risk of hospitalization.[4]

Respiratory failure has the potential to develop among individuals with chronic obstructive pulmonary disease.[5] This tends to occur during the later stages of the disease and when the patient does not adhere to the prescribed treatment measures to the greatest extent possible.[5] Among the reasons for poor treatment adherence among individuals with COPD includes failure to take the prescribed medication, discontinuation of the prescribed medication, and the cost of treatment and poor awareness about the severity of the disease.[6] Therefore, the failure to adhere to the prescribed treatment measures tends to exacerbate the inflammation and obstruction of the airways, thereby increasing the chances of respiratory failure, which includes the failure of the lungs to maintain adequate levels of carbon dioxide and oxygen within the arteries.[7]

On the other hand, non-invasive ventilation has been recognized as an important supportive measure in the care of patients with respiratory failure, especially those with COPD exacerbations.[8] Non-invasive ventilation provides ventilatory assistance via a facial or nasal mask without the need to intubate the patient's airway.[8] The major objectives of non-invasive ventilation include improving ventilation, reducing the work of breathing, and correcting gas exchange abnormalities.[9] In patients with COPD and respiratory failure, non-invasive ventilation helps to relieve hypercapnia, improve oxygenation, and relieve the respiratory muscles.[10] Non-invasive ventilation is commonly

given as bilevel positive airway pressure, whereby distinct inspiratory and expiratory pressures assist the process of respiration.[10]

Chronic obstructive pulmonary disease is a common disease among the population of Peshawar city due to a high prevalence of smokers, the use of biomass fuels for cooking, and an increase in air pollution. A considerable number of patients with poor treatment compliance due to lack of knowledge, financial issues, and inappropriate use of inhalers also contribute to the disease burden. Therefore, the need for this study arises to assess the effectiveness of non-invasive ventilators for the treatment of patients with chronic obstructive pulmonary disease who develop respiratory failure.

METHODOLOGY

A quasi experimental study was carried out in the Department of Pulmonology at MTI–HMC, Peshawar. The study period extended from 25 July 2025 to 25 January 2026. Before starting the research work, approval was obtained from the Institutional Ethical Review Committee of the hospital under approval number 2676 with approval date 01/07/2025. The sample size was calculated by using OpenEpi sample size calculator. By taking anticipated efficacy of NIV in respiratory failure due to poor treatment compliance in COPD patients as 64%,[11] with 95% confidence level and 9% absolute precision, the calculated sample size was 110 patients. Patients of both genders having age between 30–70 years and presenting with respiratory failure due to poor treatment compliance in COPD were included in the study. Patients having asthma, hemodynamic instability, trauma, or upper airway obstruction were excluded from the study. COPD was considered when spirometry showed persistent airflow limitation with post-bronchodilator FEV_1/FVC <0.70 in patients having at least 2 symptoms among chronic cough, dyspnea, and sputum production. Respiratory failure was considered when arterial blood gas showed PaO_2 <60 mmHg with $PaCO_2$ >45 mmHg and pH <7.35 in patients presenting with 2 features among dyspnea, cyanosis, and tachypnea.

After confirming eligibility, written informed consent was taken from each participant before start of data collection. The objective and possible benefit of the study were explained to all patients and they were assured that participation would not cause any risk. Basic demographic details were recorded for every patient including age, gender, profession and BMI. History regarding smoking, previous ventilation history and comorbid conditions including diabetes and hypertension was also documented. A detailed clinical assessment was carried out, including general physical examination and respiratory system assessment. Arterial blood gas analysis was performed to measure PaO2, PaCO2, and pH levels before the initiation of any form of therapy. Patients with

respiratory failure secondary to poor compliance with treatment regimens in patients with COPD were provided with non-invasive ventilation under the supervision of a pulmonologist. Non-invasive ventilation therapy was initiated, and patients were under close observation. Arterial blood gas analysis was repeated after 24 hours of initiation of non-invasive ventilation therapy to measure the response to non-invasive ventilation therapy. The efficacy of non-invasive ventilation was measured after 24 hours of initiation of non-invasive ventilation therapy and was considered to be effective if all parameters measured showed improvements, i.e., PaO2 >60 mmHg, decrease in PaCO2 by >10 mmHg, and pH >7.35.

All collected data were entered and analyzed using SPSS version 25. For categorical variables including efficacy, gender, profession, ventilation history, smoking, diabetes and hypertension frequencies and percentages were calculated. Numerical variables including age and BMI were presented as mean ± standard deviation. Efficacy was stratified with respect to age, BMI, gender, profession, ventilation history, smoking, diabetes and hypertension to evaluate effect modifiers. After stratification Chi-square test or Fisher exact test was applied where appropriate and p value $\leqslant 0.05$ was taken as statistically significant.

Results

The study included a total of 110 COPD patients, with a mean age of 53.05 ± 10.06 years and a mean BMI of 28.22 ± 3.31 kg/m^2. The sample was predominantly male, with 76(69.1%) males and 34(30.9%) females. Regarding profession, majority of patients falls under the "Other" category 49(44.5%), followed by factory workers 35(31.8%) and retired individuals 26(23.6%). Nearly half of the patients was smoker 53(48.2%), while diabetes was present in 23(20.9%) patients and hypertension was reported in 32(29.1%) patients. A prior history of ventilation was documented in 41(37.3%) patients (Table-I).

Table- I: *Patient Demographics*

n=110

Demographics	Mean ± SD
Age (Years)	53.05 ± 10.06
BMI (Kg/m^2)	28.22 ± 3.31
Gender	
Male n (%)	76 (69.1%)
Female n (%)	34 (30.9%)
Profession	
Factory Worker n (%)	35 (31.8%)
Retired n (%)	26 (23.6%)

Other n (%)	49 (44.5%)
Smoking	
Yes n (%)	53 (48.2%)
No n (%)	57 (51.8%)
Diabetes	
Yes n (%)	23 (20.9%)
No n (%)	87 (79.1%)
Hypertension	
Yes n (%)	32 (29.1%)
No n (%)	78 (70.9%)
Ventilation History	
Yes n (%)	41 (37.3%)
No n (%)	69 (62.7%)

In terms of NIV efficacy, out of 110 COPD patients, 66(60.0%) patients showing positive response to non-invasive ventilation, whereas 44(40.0%) patients did not showed favorable response, giving an overall efficacy rate of 60% in this study population (Table-II).

Table- II: ***Efficacy of Non-Invasive Ventilation Among COPD Patients***
n=110

Efficacy	Frequency	% age
Yes	66	60.00%
No	44	40.00%
Total	110	100%

Association between NIV efficacy and different demographic variables was assessed by chi-square test. In age stratification, 30 (63.8%) patients with age ⩽50 years showed efficacy, while 36 (57.1%) patients with age >50 years showed positive response, with no significant difference between groups (p=0.479). For gender, efficacy was observed in 44 (57.9%) male patients and 22 (64.7%) female patients, but this difference was not statistically significant (p=0.500). In BMI groups, same efficacy rate was seen with 12 (60.0%) patients in BMI ⩽25 and 54 (60.0%) patients in BMI >25 showing improvement (p=1.000). Regarding profession, highest efficacy was found in other profession group 34 (69.4%), followed by factory workers 19 (54.3%) and retired patients 13 (50.0%), however the difference was not significant (p=0.186). Smoking status also not showing

much difference, as 32 (60.4%) smokers and 34 (59.6%) non-smokers had almost similar response (p=0.938). In diabetes stratification, efficacy was seen in 14 (60.9%) diabetic patients and 52 (59.8%) non-diabetic patients (p=0.924). Among hypertensive patients 20 (62.5%) showed efficacy compared with 46 (59.0%) non-hypertensive patients, again not showing significant association (p=0.732). For ventilation history, patients with no previous ventilation had relatively higher efficacy 46 (66.7%) as compared to those with previous ventilation 20 (48.8%), but this difference still not reaching statistical significance (p=0.064) (Table-III).

Table- III: *Association of Efficacy of NIV with Demographic Factors*

Demographic Factors	Subgroup	Efficacy		p-value*
		Yes n(%)	No n(%)	
Age Group (years)	⩽50	30 (63.8%)	17 (36.2%)	0.479
	>50	36 (57.1%)	27 (42.9%)	
Gender	Male	44 (57.9%)	32 (42.1%)	0.500
	Female	22 (64.7%)	12 (35.3%)	
BMI (Kg/m^2)	⩽25	12 (60.0%)	8 (40.0%)	1.000
	>25	54 (60.0%)	36 (40.0%)	
Profession	Factory Worker	19 (54.3%)	16 (45.7%)	0.186
	Retired	13 (50.0%)	13 (50.0%)	
	Other	34 (69.4%)	15 (30.6%)	
Smoking	Yes	32 (60.4%)	21 (39.6%)	0.938
	No	34 (59.6%)	23 (40.4%)	
Diabetes	Yes	14 (60.9%)	9 (39.1%)	0.924
	No	52 (59.8%)	35 (40.2%)	
Hypertension	Yes	20 (62.5%)	12 (37.5%)	0.732
	No	46 (59.0%)	32 (41.0%)	
Ventilation History	Yes	20 (48.8%)	21 (51.2%)	0.064
	No	46 (66.7%)	23 (33.3%)	

*Chi-Square Test

DISCUSSION

The effectiveness of the entire process of NIV was noted in 66 patients (60.0%), which is a highly favorable response. This could be due to the fact that NIV decreases the work of breathing and increases alveolar ventilation without the need for any invasive access. This is particularly advantageous in COPD patients whose airways are already compromised due to chronic inflammation and mucus hypersecretion. With regard to the age of the patients, those who were ⩽ 50 years of age showed slightly better

efficacy in response to NIV (30/47; 63.8%) than those who were > 50 years of age (36/63; 57.1%), although the difference is statistically insignificant (p = 0.479). This could be due to the fact that younger patients have more reserve in their muscles of respiration and their airways have not undergone as much remodeling as in older patients. Thus, the positive pressure ventilation is better tolerated in younger patients. Female patients showed better efficacy in response to NIV (22/34; 64.7%) than male patients (44/76; 57.9%), although the difference is statistically insignificant (p = 0.500). This could be due to the fact that the lungs of female patients have a different type of inflammatory cytokine response to the progression of COPD. Also, the emphysematous changes in female patients may be relatively less than those in male patients. Thus, the response to positive pressure ventilation is relatively better in female patients. Patients who have never used the ventilation support showed better efficacy in response to NIV (46/69; 66.7%) than those who have used the ventilation support in the past (20/41; 48.8%), although the difference is statistically insignificant (p = 0.064). This is clinically relevant as the repeated use of ventilation in COPD patients could be indicative of the progression of the underlying COPD pathophysiology.

The overall NIV efficacy was found in 66(60.0%) patients in present study, which is comparable to findings of Kansal *et al.* [11] who also reported 64% success rate in respiratory failure patients, suggesting that NIV is a moderately effective intervention across different clinical settings. However, this rate was considerably lower than what was reported by Ağca *et al.* [12] where success was achieved in 477(88%) patients, and Pandey *et al.* [13] who observed even higher success in 27(96.4%) patients. This difference may be explaining by the fact that both these studies was including patients with more severe acute hypercapnic respiratory failure where NIV response is more dramatic and measurable, whereas present study was focusing specifically on patients with poor treatment compliance, which itself is a negative prognostic factor for ventilatory outcomes. Poor compliance leading to repeated exacerbations and progressive decline in respiratory muscle function, which ultimately reducing the effectiveness of NIV support. This is further supported by Woodrow *et al.*[14] who demonstrated in a Cochrane analysis that NIV significantly reduced $PaCO_2$ and all-cause mortality in stable COPD patients, indicating that consistent and compliant use of NIV is a key determinant of its therapeutic benefit. Regarding age, patients of ⩽50 years showing slightly better efficacy 30(63.8%) as compared to older patients >50 years 36(57.1%), though not significant (p=0.479). This is somewhat consistent with observations by Shah *et al.* [15] who highlighted that higher APACHE II scores and persistent physiological deterioration, more commonly seen in older patients, are associated with NIV failure, scientifically

supporting the trend observed in present study. Additionally, Pandey *et al.*[13] reported a mean age of 66.5 years in their cohort with 79% patients belonging to 60–80 years age group, yet still achieving high success rates, which suggesting that age alone may not be a decisive factor but rather the overall physiological reserve and disease severity at time of NIV initiation is more important in determining outcome.

Patients without prior ventilation history was showing better NIV response 46(66.7%) compared to those with previous ventilation history 20(48.8%), with p value approaching significance (p=0.064). This finding is in agreement with Ağca *et al.* [12] who reported that higher Charlson comorbidity index and repeated clinical deterioration was associated with poorer NIV outcomes, as repeated ventilatory episodes may indicating progressive respiratory muscle fatigue and worsening airway remodeling in COPD. Sabir *et al.* [16] also observed that despite physiological improvements in $PaCO_2$ and HCO_3 after NIV, no significant clinical outcome difference was found between high and low intensity ventilation groups, which further suggesting that underlying disease burden and prior ventilatory history may be playing more important role than ventilation intensity alone in determining treatment response. Gender, BMI, smoking, diabetes and hypertension was not showing any significant association with NIV efficacy in present study, which is largely consistent with existing literature as most studies including Khilnani *et al.* [17] and Roberts *et al.* [18] was focusing on physiological parameters like arterial pH, $PaCO_2$ and respiratory rate as main predictors of NIV outcome rather than demographic variables, suggesting these factors may have limited independent influence on ventilatory response. This observation is also supported by Shah *et al.* [15] who emphasized that failure of NIV is more strongly predicted by persistent tachycardia, acidosis and diaphragmatic dysfunction rather than by patient demographic characteristics, which is consistent with the non-significant demographic associations observed in present study.

There are some limitations to this study. First, the study was conducted at a single center as a quasi-experimental design with a small sample size of 110 patients. This limits the generalizability of the study to the larger COPD patient population. Secondly, the study did not have a proper control group since it is a quasi-experimental design. This limits the ability to determine the true efficacy of NIV with respect to conventional medical therapy alone. Thirdly, the study did not analyze the arterial blood gas parameters such as pH and PaCO2 levels, which are known predictors of success with NIV as per the literature.

Conclusion

The present study concludes that the use of non-invasive ventilation is a moderately effective intervention for COPD patients who show poor treatment compliance. Moreover, the study found that previous ventilation use showed a trend towards a blunted response to NIV use, possibly due to increased underlying disease burden.

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Conflict of Interest

The author declares that there is no conflict of interest related to this research work.

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