

# Frequency and Determinants of Respiratory Failure in Acute Exacerbation of Chronic Obstructive Pulmonary Disease Patients: A Cross-Sectional Study

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## Abstract

**Background:** Chronic obstructive pulmonary disease (COPD) is slowly and progressive disorder that is characterized by a permanent or partially reversible obstruction of airflow. A COPD exacerbation can have a variety of clinical outcomes, from self-limited sickness to progressive respiratory failure.

**Objective:** To determine the prevalence and factors associated with respiratory failure among patients experiencing acute exacerbation of chronic obstructive pulmonary disease (COPD).

**Objective:** The study was designed to evaluate maternal complications of emergency vs elective cesarean section for placenta previa.

**Material and Methods:** This cross-sectional study was conducted at the Department of Pulmonology in Khalifa Gul Nawaz (KGN), MTI Bannu from January 2022 to December 2022, following approval from the institutional ethical committee. A total of 385 participants were enrolled in this study. Following the documentation of the physical examination and clinical history, various demographic details were noted. The data was analyzed through SPSS Version 25.0.

**Results:** A total of 385 patients presented with acute exacerbation of COPD were assessed. Out of which 258 were males (67%) and 127 (32.9%) were females. In an acute exacerbation of COPD, the number of individuals presenting with respiratory failure was 138 (35.8%). out of which 91 (23.6%) were males and 47 (12.2%) were females. The age group of 51 to 60 years old had the highest number of individuals experiencing respiratory failure, which were 69 (17.9%).

**Conclusion:** In the current study the frequency of respiratory failure in the participants presented with acute exacerbation was high. It is crucial to create efficient plans for stopping smoking and preventing COPD exacerbations in light of its effect on health care resources

**Keywords:** Respiratory failure, acute exacerbation, chronic obstructive pulmonary disease

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## Introduction:

Chronic obstructive pulmonary disease (COPD) is slowly and progressive disorder that is characterized by a permanent or partially reversible obstruction of airflow.<sup>1, 2</sup> Globally their prevalence is approximately 10% in people who are older than forty years.<sup>3, 4</sup> The increased death rate, morbidity, and expenditures on healthcare resulting from chronic obstructive pulmonary disease are mostly caused by acute exacerbations of the condition.<sup>5, 6</sup> The most common sign of a chronic obstructive pulmonary disease (COPD) exacerbation is an change in the individual's normal dyspnea, cough,

and sputum production that goes beyond typical daily fluctuations.<sup>7,8</sup>

A COPD exacerbation can have a variety of clinical outcomes, from self-limited sickness to progressive respiratory failure.<sup>9</sup> In a Chinese research, analysis of arterial blood gases confirmed respiratory failure in 46.5 percent of the individuals hospitalized with acute exacerbation of COPD.<sup>10</sup> An arterial carbon dioxide tension (PaCO<sub>2</sub>) of more than 45 mmHg or an arterial oxygen tension (PaO<sub>2</sub>) of less than 60 mmHg are indications of respiratory failure.<sup>11</sup> Hospital treatment for respiratory failure involves the use of antibiotics, glucocorticosteroids, bronchodilator therapy, controlled

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oxygen therapy, and/or ventilation support, which may involve non-invasive or invasive ventilation.<sup>12-15</sup> When an individual's COPD exacerbation occurs, non-invasive ventilation is a successful therapy for respiratory failure.<sup>16</sup> Whenever it is intended to reduce the high death rate (28%) attributed to the disease, appropriate facilities, including non-invasive ventilation, must be set up in hospitals admitting extremely seriously ill individuals. These facilities are provided in a small number of centers in Pakistan.<sup>17</sup> The current study was carried out to explore the incidence respiratory failure in individuals admitted with acute exacerbation of chronic obstructive pulmonary disease.

## Materials and Methods:

**Study design:** Cross Sectional Descriptive

**Sample size:** A total of 385 participants were enrolled in this study.

### Inclusion criteria

Patients of both genders above 40 years of age presented to the pulmonology ward having COPD with acute exacerbation were included in this study.

### Exclusion criteria

Individuals having COPD with asthma, heart arrhythmia, left ventricular failure with pulmonary edema, bronchogenic cancer, copd with pulmonary fibrosis were excluded.

### Data collection:

The term acute exacerbation of chronic obstructive pulmonary disease" refers to patients who have been diagnosed with COPD based on prior spirometry records (FEV1 less than 80% predicted and post bronchodilator FEV1/FVC ratio less than 70%), and who exhibit dyspnea at rest (defined as taking more than <sup>25</sup> breaths per minute, as determined by timing the number of breaths in a minute with a stopwatch), increase in sputum production (more than 30 milliliters per twelve hours, as determined by collecting the sputum and measuring it in a graduated glass beaker in the ward) and sputum purulence (more than 25 pus cells per low-power field of sputum as identified by sputum microscopy, a microscope-based procedure carried out in a medical laboratory) for the last two days . While arterial oxygen tension ((PaO<sub>2</sub> ) was used to diagnose individuals with respiratory failure.Pao<sub>2</sub> less than 60 mmHg and/or an arterial carbon dioxide tension more than 45 mmHg, which were determined by using a blood gas analyzer equipment . Following the documentation of the physical examination and clinical history, various demographic details were noted. Immediately at the exact time of presentation, a 3 ml blood sample was taken using aseptic procedure from the radial artery. To prevent blood clotting, a sterile, five milliliter syringe

containing 0.5 ml of heparin was used. The sample was directly subjected to an arterial blood gas analyzer (A VL Compact 2 Radiometer, Denmark) to measure the corresponding partial pressures of both carbon dioxide and oxygen.

## Data Analysis

Within ten minutes of sample collection at room temperature, analysis was conducted. Age, sex, respiratory failure, partial pressure of carbon dioxide (PaCO<sub>2</sub>), partial pressure of oxygen (PaO<sub>2</sub>), arterial blood PH, and bicarbonate level are among the study variables. The data was analyzed through SPSS Version 25. Data was presented in mean standard deviation and percentage.

## Results:

A total of 385 patients presented with acute exacerbation of COPD were assessed. Out of which 258 were males (67%) and 127( 32.9%) were females. 57.3 years  $\pm$  10.3SD was the mean age of male individuals and 57.3 years  $\pm$  10.3SD was the mean age of female participants. In an acute exacerbation of COPD, the number of individuals presenting with respiratory failure was 138 (35.8%).out of which 91(23.6%) were males and 47(12.2%) were females. The age group of 51 to 60 years old had the highest number of individuals experiencing respiratory failure, which was 69(17.9%) and the lowest number of patients in the age range of 71 to 80 years was 15 (3.89%) as presented in Table 1. On arterial blood gas analysis for both male and female recipients, the mean pH was 7.3  $\pm$  2.1 SD and 7.3  $\pm$  2.7 SD, respectively, resulting in an overall mean pH value of 7.3  $\pm$  2.5 SD. The arterial oxygen tension was 60.8 mmHg  $\pm$  6.8SD and the mean partial pressure of carbon dioxide was 55.0 mmHg  $\pm$  7.4SD, correspondingly. The mean HCO<sub>3</sub> level was recorded as 28.4 mmol/L  $\pm$ 1.4SD as shown in Table 2. The overall study population's stratification and the percentages of each age category is shown in Table 3.

**Table – 1: Gender and age wise distribution of participants with and without Respiratory Failure in Acute Exacerbation of COPD.**

Age in years	Respiratory failure			
	Yes		No	
	Male	Female	Male	Female
40-50	15(3.89%)	13(3.37%)	24(6.23%)	20(5.19%)
51-60	46(11.9%)	23(5.97%)	10(2.5%)	35(9.0%)
61-70	20(5.1%)	6(1.5%)	15(3.89%)	17(4.41%)
71-80	10(2.59%)	5(1.29%)	25(6.49%)	8(2.0%)
<b>Total</b>	91(23.6%)	47(12.2%)	147(43.37%)	80(20.7)

<b>Grand total</b>	138(35.84%)	247 (64.1%)		
<b>Table – 2: Analysis of arterial blood gas in COPD individuals experiencing an acute exacerbation with T-II Respiratory failure</b>				
<b>Gender</b>	<b>Gender</b>			
<b>Male</b>	<b>Male</b>	<b>Male</b>	<b>Male</b>	<b>Male</b>
<b>Female</b>	<b>Female</b>	<b>Female</b>	<b>Female</b>	<b>Female</b>
<b>Total</b>	<b>Total</b>	<b>Total</b>	<b>Total</b>	<b>Total</b>

<b>Table – 3: The overall study population's stratification and the percentages of each age category N=138</b>		
<b>Age in years</b>	<b>Respiratory Failure Participants</b>	<b>%age</b>
40-50	29	7.5
51-60	68	17.6
61-70	26	6.7
71-80	15	3.89

## Discussion:

The exacerbation of chronic obstructive pulmonary disease can result in important clinical implications, such as respiratory failure and a considerable need for health care resources.<sup>19</sup> COPD is a severe socioeconomic burden and one of the world's leading causes of death, with a steadily growing mortality rate from consequences such as respiratory failure. Recurrent exacerbations and a steady loss in lung function are hallmarks of the normal course of COPD. There is a chance that respiratory failure will occur; requiring ICU and hospital stay for normal breathing.<sup>20</sup>

In the current study we evaluated the frequency of respiratory failure in individuals admitted with acute exacerbation COPD. On arterial blood gas analysis the incidence of respiratory failure in the participants with current study with acute exacerbation was 35.84%. The results of the current study are similar to international writings. In an Indian research, 33.8% of patients had respiratory failure when laboratory abnormalities were presented on an analysis of arterial blood gases.<sup>21</sup> According to arterial blood gas analysis, 46.5% of patients had respiratory failure following an acute exacerbation of obstructive pulmonary disease in a multicenter retrospective research carried out in four hospitals in China.<sup>22</sup>

According to other research in the literature, respiratory failure can occur anywhere between sixteen percent and thirty-five percent of the time, and its total death rate can range from thirty-five percent to 43 percent.<sup>23</sup> According

to Corrado et al., 12.5% of patients who have an acute exacerbation of chronic obstructive pulmonary disease also experience an acute form of chronic respiratory failure.<sup>24</sup> In our research, the dominance of men was observed (67%).

Other research in the international literature have demonstrated a similar male dominance in the same way. In the Indian research, 80.7% of the participants were men.<sup>20</sup> In another research, patients with acute exacerbation of COPD were 87.9% male.<sup>(21)</sup> The main cause of more males with COPD in our study is smoking. In our society majority of males are smokers as compared to females. The mean age of the patients in our research was 59.3 years  $\pm$  10.76SD, although in the literature, the same patients' mean age has been recorded as 70 years  $\pm$  8.0SD years.<sup>20</sup> Certain authors claim that an advanced age is a predictive factor for in-hospital death.<sup>20</sup>

Based on arterial blood gas analysis, our study's mean pH value was 7.3  $\pm$  2.5SD. When supportive treatment and controlled oxygen therapy are ineffective for patients with serious acidosis (with a pH < 7.26) or an increasing partial pressure that exceeds the arterial CO<sub>2</sub> level, ventilator support (non-exacerbation of chronic obstructive pulmonary disease) should be considered. A pH level higher than 7.26 indicates a higher likelihood of survival in the event of an acute episode.<sup>25</sup> One significant limitation in our analysis was the classification of respiratory failure as either acute or chronic.

## Conclusion:

In the current study the frequency of respiratory failure in the participants presented with acute exacerbation was high (35.5%). It is crucial to create efficient plans for stopping smoking and preventing COPD exacerbations in light of its effect on health care resources.

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