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Clinical Profile and Determinants of Hypoxemia among Patients Admitted to a Tertiary Respiratory Care Centre in Rajasthan, India

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ABSTRACT

Background: Hypoxemia is a common and serious clinical problem in patients with respiratory illnesses, often predicting worse outcomes. Understanding its clinical profile and associated determinants is crucial for timely recognition and management, especially in tertiary care settings.
Objectives: To describe the clinical and demographic profile of hypoxemic patients admitted to a tertiary respiratory care centre and to identify determinants associated with severity of hypoxemia.
Methods: A cross-sectional study was conducted among 40 hypoxemic patients admitted to the Institute of Respiratory Diseases, Tertiary care Hospital in Rajasthan. Demographic data, clinical features, and arterial blood gas parameters were recorded. Hypoxemia was categorized based on PaO_2 values. Factors associated with severe hypoxemia were analyzed.
Results: Most patients were males in the middle to older age group. COPD and pneumonia were the most common underlying conditions. Severe hypoxemia (PaO_2 < 60 mmHg) was observed in nearly half the patients. Factors significantly associated with severe hypoxemia included older age, presence of comorbidities, and underlying parenchymal lung disease.
Conclusion: Hypoxemia is frequent among adults admitted with respiratory illnesses, particularly COPD and pneumonia. Clinical severity correlates with age, comorbidities, and underlying lung pathology. Early detection and targeted management are essential to improve outcomes.

Keywords: *Hypoxemia, clinical profile, determinants, COPD, pneumonia, arterial blood gas, tertiary care.*

INTRODUCTION

Hypoxemia is a critical physiological abnormality that reflects inadequate oxygenation of arterial blood and is associated with increased morbidity and mortality in respiratory illnesses. Globally, hypoxemia contributes to a significant proportion of hospital admissions and adverse outcomes, particularly in low- and middle-income countries.

In India, respiratory diseases such as chronic obstructive pulmonary disease (COPD), pneumonia, interstitial lung disease, and acute lower respiratory tract infections contribute heavily to the burden of hypoxemia. Early identification and management are crucial, as hypoxemia is a strong predictor of severity and outcome, often guiding decisions regarding oxygen therapy, intensive care, and mechanical ventilation.

Previous studies have predominantly focused on pediatric populations or acute infectious illnesses. However, comprehensive data on the **clinical profile and determinants of hypoxemia among adults** in tertiary respiratory centers in India remain limited.

This study aimed to analyze the demographic and clinical characteristics of hypoxemic patients and to identify factors associated with severe hypoxemia at a tertiary respiratory care centre in Rajasthan.

MATERIALS AND METHODS

Study Design and Setting

This was a cross-sectional observational study conducted at the Institute of Respiratory Diseases, of a Tertiary care Hospital North West zone Rajasthan.

Study Population

- **Sample size:** 40 adult patients.
- **Inclusion criteria:** Patients admitted with $SpO_2 < 90\%$ at room air.
- **Exclusion criteria:** Patients with poor peripheral perfusion, shock, or factors interfering with oximetry accuracy.

Data Collection

Detailed demographic information, history, clinical examination findings, diagnosis, and comorbidities were recorded. Arterial blood gas (ABG) analysis was performed at admission.

Severity of hypoxemia was classified based on PaO_2 values:

- **Mild:** 60–80 mmHg
- **Moderate:** 40–59 mmHg
- **Severe:** < 40 mmHg

Statistical Analysis

- Descriptive statistics for demographic and clinical characteristics.
- Chi-square test and Student's t-test to identify factors associated with severity of hypoxemia.
- $p < 0.05$ considered statistically significant.

RESULTS

Table 1: Demographic Characteristics

Variable	Category	Number (%)
Age (years)	Mean ± SD	53.63 ± 11.23
Age Group	18–39	6 (15%)
	40–59	18 (45%)
	≥60	16 (40%)
Sex	Male	26 (65%)
	Female	14 (35%)
Residence	Urban	16 (40%)
	Rural	24 (60%)
Smoking Status	Smoker	18 (45%)
	Non-smoker	22 (55%)

The study group consisted of 40 patients, comprising 26 (65%) men and 14 (35%) women. In the study population, 18 cases were either chronic or occasional (at least twice a week) smokers. Seventeen men and one woman had a smoking habit.

When we compiled the age Distribution. We found that the average age of the group was 53.6363 ± 11.23 years. The average age of males was 52.92 ± 11.66 years, and that of females was 54.93 ± 10.68 years. A comparison of age between male and female cases did not show any statistical significanceThe study group had 16 patients from an urban area and 24 cases from a rural area. Among the urban cases, 11 were men and 5 were women. Among the rural cases, 15 were men and 9 were women

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Table 2: Clinical Presentation

Clinical Feature	Number (%)
Dyspnea	38 (95%)
Cough	32 (80%)
Fever	22 (55%)
Wheeze	16 (40%)
Cyanosis	11 (27.5%)
Altered Sensorium	6 (15%)
Tachypnea (>24/min)	29 (72.5%)
Tachycardia (>100/min)	17 (42.5%)

Table 3: Underlying Respiratory Diseases

Diagnosis	Number (%)
COPD	14 (35%)
Pneumonia	10 (25%)
ILD	5 (12.5%)
Bronchial Asthma	4 (10%)
Pulmonary Tuberculosis	3 (7.5%)
ARDS	2 (5%)
Pleural Effusion/Empyema	2 (5%)

Table 4: Arterial Blood Gas Profile

Parameter	Mean ± SD	Range
pH	7.37 ± 0.06	7.21–7.48
PaO_2 (mmHg)	54.8 ± 12.9	28–84
$PaCO_2$ (mmHg)	42.5 ± 8.2	29–66
HCO_3^- (mmol/L)	22.1 ± 3.8	16–30
SaO_2 (%)	88.3 ± 6.7	68–96

Table 5: Severity of Hypoxemia

Severity	PaO_2 (mmHg)	Number (%)
Mild	60–80	11 (27.5%)
Moderate	40–59	19 (47.5%)
Severe	<40	10 (25%)

Table 6: Determinants of Severe Hypoxemia

Variable	Severe Hypoxemia (n=10)	No Severe Hypoxemia (n=30)	p-value
Age ≥60 years	7 (70%)	9 (30%)	0.01
Smoking	7 (70%)	11 (36.7%)	0.06
COPD/ILD	8 (80%)	11 (36.7%)	0.02
Comorbidities	6 (60%)	7 (23.3%)	0.03
Cyanosis	8 (80%)	3 (10%)	0.001
Tachypnea	9 (90%)	20 (66.7%)	0.15

DISCUSSION

This study provides valuable insight into the clinical profile and determinants of hypoxemia in adults admitted to a tertiary respiratory care centre in Rajasthan.

Similar to previous Indian studies, COPD and pneumonia were the predominant underlying conditions associated with hypoxemia. This reflects the high prevalence of chronic respiratory diseases and late presentations to tertiary hospitals.

Older age and comorbidities were significant determinants of severe hypoxemia, consistent with literature showing poorer physiological reserves and increased disease burden in elderly patients. Cyanosis and altered sensorium were more common in severe cases, highlighting their importance as bedside clinical indicators of severity.

Our findings are in agreement with studies such as Razi et al. (2012) and Wilson et al. (2010), which reported that COPD, pneumonia, and advanced age are major risk factors for severe hypoxemia and poor outcomes. This study provides an important profile of hypoxemia among adults presenting to a tertiary respiratory care centre in Rajasthan. The mean age (~54 years) and male predominance in our cohort parallels the demographic structure of chronic respiratory disease in India. Similar observations have been reported in studies by Razi et al. (2012) and Rose et al. (2022), where males formed the largest proportion of hypoxemic admissions due to higher smoking rates and occupational exposures.

Underlying Respiratory Diseases

COPD (35%) and pneumonia (25%) constituted the major causes of hypoxemia in this population. This is consistent with national and global observations where COPD remains the second-leading cause of mortality in India. Studies by Rauniyar et al. (2020) and Pentakota et al. (2016) also showed a high prevalence of COPD in hypoxemic patients requiring hospital evaluation.

Interstitial lung disease accounted for 12.5% of cases, a trend reflective of increasing ILD detection in India. Pneumonia-associated hypoxemia demonstrated moderate to severe desaturation in most cases, similar to findings by Wilson et al. (2010).

Association with Age and Comorbidities

The association of severe hypoxemia with age ≥60 years was statistically significant (p=0.01). Age-related changes, including reduced pulmonary compliance, impaired diffusion capacity, and comorbidity clustering, have been well documented as contributors to hypoxemia (Harrison et al., 2008).Comorbidities (diabetes, hypertension, ischemic heart disease) also showed significant association with severe hypoxemia, consistent with the work of West (2000) and Dempsey (1999), emphasizing that reduced cardiovascular reserve exacerbates tissue hypoxia even at comparable PaO_2 levels.

Clinical Predictors

Cyanosis was highly predictive of severe hypoxemia (p<0.001), aligning with traditional clinical teaching and confirmed in recent ICU-based studies by Jubran (2015). Tachypnea was common but less specific.

ABG Findings

The mean PaO_2 (54.8 mmHg) reinforces the importance of ABG confirmation, as pulse oximetry alone may underestimate severity in conditions such as ILD or COPD with V/Q mismatch. Similar observations were made by Elhossieny et al. (2020), who found discrepancies between SpO_2 and SaO_2 in hypoxic patients.

Comparison with Previous Research

The high prevalence of moderate to severe hypoxemia mirrors global estimates from LMICs, where late presentation and limited access to early respiratory care play an important role. Studies from Nepal, Iran, and the Middle East also report similar patterns.

Implications

Early detection of hypoxemia significantly influences the need for oxygen therapy, non-invasive ventilation, and ICU triage. Identifying high-risk groups (elderly, COPD/ILD, comorbid patients) can improve outcomes.

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