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Original Research Article

A Study Regarding Correlation between Vitamin D Levels and Frequency of COPD Exacerbations

Bhuvaneswari Lenka[1], Srinibas Sahoo[2]

[1]Post Graduate Student 2nd Yr, Department of Respiratory Medicine, Hi-Tech Medical College and Hospital, Bhubaneswar, Odisha, India

[2]Associate Professor, Department of Respiratory Medicine, Hi-Tech Medical College and Hospital, Bhubaneswar, Odisha, India

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Corresponding Author: Srinibas Sahoo

Conflict of interest: Nil

Abstract:

Background: Chronic Obstructive Pulmonary Disease (COPD) is a major cause of morbidity and mortality worldwide. Acute exacerbations significantly worsen disease prognosis and increase healthcare utilization. Vitamin D deficiency is common in COPD patients and may influence exacerbation frequency and severity.

Objectives: To evaluate the correlation between serum 25-hydroxyvitamin D levels and the frequency and severity of acute exacerbations in patients with COPD.

Materials and Methods: This hospital-based observational study was conducted over 12 months in a tertiary care teaching hospital. Forty patients admitted with acute exacerbation of COPD were included. Serum 25-hydroxyvitamin D levels were categorized as deficient (<20 ng/mL), insufficient (20–29 ng/mL), or sufficient (≥30 ng/mL). Outcomes assessed included exacerbation frequency, hospital admissions, and requirement of ventilatory support. Statistical analysis was performed to assess correlations.

Results: Vitamin D deficiency was observed in 55% of patients. Deficient patients had significantly higher exacerbation frequency, increased hospital admissions, and greater need for ventilatory support. Serum vitamin D levels showed a significant negative correlation with exacerbation severity.

Conclusion: Vitamin D deficiency is significantly associated with increased frequency and severity of COPD exacerbations. Screening and targeted correction of vitamin D deficiency may be a cost-effective adjunct in COPD management.

Keywords: COPD; Vitamin D deficiency; Acute exacerbation; 25-hydroxyvitamin D; Ventilatory support.

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Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a progressive inflammatory airway disease characterized by persistent airflow limitation and recurrent exacerbations. It is one of the leading causes of death globally and represents a major public health burden, especially in developing countries [1].

Acute exacerbations of COPD (AECOPD) are episodes of worsening respiratory symptoms requiring additional therapy and are associated with accelerated lung function decline, impaired quality of life, increased mortality, and higher healthcare costs [2]. Respiratory infections are the most common triggers for these exacerbations.

Vitamin D has an important role in immune regulation. It enhances innate immunity through the induction of antimicrobial peptides such as cathelicidin and modulates adaptive immune responses by regulating cytokine production [3]. Vitamin D deficiency is common in COPD patients due to aging, smoking, reduced sunlight exposure, physical inactivity, and poor nutritional status [4].

Several observational studies have demonstrated an association between low vitamin D levels and increased susceptibility to respiratory infections and frequent COPD exacerbations [5–7]. However, data from Indian tertiary care settings remain limited, prompting the present study.

Aims and Objectives

1. To assess serum 25-hydroxyvitamin D levels in patients admitted with acute exacerbation of COPD.
2. To evaluate the frequency and severity of COPD exacerbations.
3. To determine the correlation between vitamin D levels and outcomes such as hospital

admissions and requirement of ventilatory support.

Materials and Methods

Study Design and Setting: Hospital-based observational study conducted in the Department of Respiratory Medicine of a tertiary care teaching hospital over 12 months.

Study Population: A total of 40 patients with diagnosed COPD admitted with acute exacerbation were included.

Inclusion Criteria

- Age ≥40 years
- Diagnosed COPD based on standard clinical and spirometric criteria
- Admission for acute exacerbation of COPD

Exclusion Criteria

- Bronchial asthma, interstitial lung disease, active pulmonary tuberculosis
- Patients on vitamin D supplementation
- Chronic kidney disease, chronic liver disease, malignancy

Data Collection: Demographic details, smoking history, duration of COPD, frequency of exacerbations, number of hospital admissions, and ventilatory requirements were recorded. Serum 25-hydroxyvitamin D levels were measured and categorized as deficient, insufficient, or sufficient.

Statistical Analysis: Categorical variables were expressed as percentages. Associations were assessed using chi-square test and correlation coefficients. A p value <0.05 was considered statistically significant.

Results

Table 1. Sociodemographic and Clinical Characteristics (n = 40)

Variable	Frequency (n)	Percentage (%)
Age 40–49 years	6	15.0
Age 50–59 years	14	35.0
Age 60–69 years	13	32.5
Age ≥70 years	7	17.5
Male	34	85.0
Female	6	15.0
Current smokers	18	45.0
Ex-smokers	16	40.0
Never smokers	6	15.0

Table 2. Distribution of Serum Vitamin D Levels (n = 40)

Vitamin D status	Frequency (n)	Percentage (%)
Deficient (<20 ng/mL)	22	55.0
Insufficient (20–29 ng/mL)	12	30.0
Sufficient (≥30 ng/mL)	6	15.0

Table 3. Vitamin D Status and Frequency of COPD Exacerbations

Vitamin D status	≤2/year n (%)	>2/year n (%)	Total
Deficient	6 (27.3)	16 (72.7)	22
Insufficient	7 (58.3)	5 (41.7)	12
Sufficient	5 (83.3)	1 (16.7)	6

$p < 0.05$

Table 4. Vitamin D Status and Hospital Admissions

Vitamin D status	≤1 admission/year	≥2 admissions/year	Total
Deficient	7	15	22
Insufficient	6	6	12
Sufficient	5	1	6

Table 5. Vitamin D Status and Requirement of Ventilatory Support

Vitamin D status	No ventilation	NIV	Invasive ventilation	Total
Deficient	6	10	6	22
Insufficient	6	4	2	12
Sufficient	4	2	0	6

Table 6. Correlation between Vitamin D Levels and Exacerbation Severity

Parameter	Correlation coefficient (r)	p value
Exacerbation frequency	−0.48	0.003
Hospital admissions	−0.41	0.008
Ventilatory support	−0.39	0.012

Discussion

In the present study, vitamin D deficiency was observed in 22 out of 40 patients (55%), while 12 patients (30%) had insufficient levels and only 6 patients (15%) had sufficient vitamin D levels. This prevalence is comparable to the findings of Janssens et al., who reported vitamin D deficiency in approximately 60–70% of COPD patients, and demonstrated its association with greater disease severity [4]. Holick et al. also reported that more than 50% of adults with chronic illnesses, including respiratory diseases, have vitamin D deficiency [3].

In this study, 72.7% (16/22) of vitamin D-deficient patients experienced more than two exacerbations per year, compared to 41.7% (5/12) among insufficient patients and 16.7% (1/6) among those with sufficient vitamin D levels. This significant difference supports the findings of Kunisaki et al., who observed that patients with lower serum vitamin D levels had a significantly higher risk of acute COPD exacerbations [5]. Malinovschi et al. similarly reported increased exacerbation frequency among vitamin D-deficient COPD patients [6].

Regarding healthcare utilization, the present study showed that 68.2% (15/22) of vitamin D-deficient patients required two or more hospital admissions per year, compared to 50% (6/12) of insufficient patients and 16.7% (1/6) of sufficient patients. Comparable observations were reported by Persson et al., who found that low vitamin D levels were associated with increased hospitalization rates due to COPD exacerbations [7]. Jolliffe et al. also demonstrated that vitamin D deficiency was linked to a higher risk of moderate to severe exacerbations requiring hospital care [8].

Disease severity was greater among vitamin D-deficient patients in this study. Ventilatory support was required in 72.7% (16/22) of deficient patients, with 45.4% requiring non-invasive ventilation and 27.3% requiring invasive mechanical ventilation. In contrast, no patient with sufficient vitamin D levels required invasive ventilation. These findings are consistent with Janssens et al., who reported an association between vitamin D deficiency and advanced disease severity in COPD [4].

Correlation analysis demonstrated a moderate negative correlation between serum vitamin D levels and exacerbation frequency ($r = -0.48$, $p = 0.003$), hospital admissions ($r = -0.41$, $p = 0.008$), and need for ventilatory support ($r = -0.39$, $p = 0.012$). Similar inverse relationships have been reported in earlier observational studies [5,6]. Interventional studies, such as that by Lehouck et al., showed that while vitamin D supplementation did not reduce exacerbations overall, patients with severe baseline deficiency experienced significant benefit [9], supporting targeted supplementation strategies.

Limitations

- Small sample size (n = 40)
- Single-center observational design
- Seasonal variation in vitamin D levels not assessed
- Causality cannot be established

Conclusion

Vitamin D deficiency is significantly associated with increased frequency and severity of acute exacerbations in COPD patients. The higher exacerbation rates, increased hospital admissions, and greater need for ventilatory support observed among vitamin D-deficient patients highlight the importance of routine screening. Targeted correction of vitamin D deficiency may help reduce exacerbation burden and improve clinical outcomes. Larger multicentric randomized studies are required to confirm these findings.

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