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Original Research Article

A Prospective Study on Effect of Vitamin D Levels on Forced Vital Capacity in COPD Patients in a Tertiary Care Hospital

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Abstract

Background: Chronic Obstructive Pulmonary Disease (COPD) is frequently associated with vitamin D deficiency, which may worsen lung function and exacerbate disease severity. Forced Vital Capacity (FVC) is a major indicator of pulmonary performance.

Objective: To evaluate the relationship between serum vitamin D levels and FVC among COPD patients in a tertiary care hospital.

Methods: A prospective study was conducted over 12 months involving 50 stable COPD patients. Serum 25-hydroxyvitamin D [25(OH) D] levels were measured and categorized into deficient (<20 ng/mL), insufficient (20–30 ng/mL), and sufficient (>30 ng/mL). FVC (% predicted) was assessed using spirometry.

Results: Of 50 patients, 32 (64%) had vitamin D deficiency, 12 (24%) had insufficiency, and 6 (12%) had sufficient levels. Mean FVC was significantly lower in vitamin D–deficient patients (56.8 ± 9.4%) compared to insufficient (63.2 ± 8.1%) and sufficient groups (70.1 ± 7.3%) ($P < 0.01$). A positive correlation was observed between serum vitamin D and FVC ($r = 0.52$, $p = 0.001$).

Conclusion: Lower vitamin D levels are significantly associated with reduced FVC in COPD patients. Screening and correction of vitamin D deficiency may improve lung function outcomes.

Keywords: Chronic Obstructive Pulmonary Disease, Vitamin D Deficiency, Forced Vital Capacity, Pulmonary Function.

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Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a long-term lung disorder characterized by persistent airflow restriction, chronic respiratory symptoms, and progressive structural alterations within the airways and lung tissues. It is recognized as one of the major global health challenges, contributing heavily to illness, disability, and premature mortality.

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) reports that COPD is expected to rank among the top three causes of death worldwide, highlighting the urgent need to understand factors that influence its course and outcome. In recent years, the role of micronutrients—especially vitamin D—has gained prominence in COPD research. Vitamin D is a fat-soluble vitamin obtained mainly through sunlight exposure, with smaller amounts supplied by diet. While traditionally associated with calcium regulation and bone health, vitamin D also exerts significant effects on immune pathways, inflammatory processes, and skeletal and respiratory muscle strength.

These additional biological roles have led to growing interest in its potential involvement in chronic respiratory diseases. Many studies indicate that vitamin D deficiency is highly prevalent in individuals with COPD, likely due to reduced outdoor activities, inadequate diet, advancing age, and chronic inflammation—all factors commonly

linked to this condition. Forced Vital Capacity (FVC), an essential parameter measured during spirometry, reflects the maximum volume of air exhaled forcefully after a deep inhalation. It is a key indicator of pulmonary performance and disease severity in COPD patients. Declines in FVC are associated with increased airway obstruction, lung hyperinflation, reduced respiratory muscle function, and systemic inflammation. Given that vitamin D contributes to muscle strength and modulates inflammatory responses, insufficient levels may adversely influence lung function parameters such as FVC.

Although international evidence supports a possible association between low vitamin D levels and poorer lung function, research focusing on this relationship within the Indian population is relatively scarce. In India, widespread vitamin D deficiency is observed due to factors such as darker skin tones, cultural clothing practices, suboptimal dietary intake, and limited exposure to sunlight. These conditions may further compound the burden of chronic respiratory diseases, making the exploration of vitamin D's role in COPD particularly relevant.

Understanding this association may help determine whether evaluating and correcting vitamin D levels could serve as an additional strategy to improve respiratory outcomes and enhance overall management of COPD.

Aim and Objectives: The present study aims to investigate the relationship between serum vitamin D concentrations and Forced Vital Capacity among COPD patients in a tertiary care hospital.

Materials and Methods

Study Design and Setting: A prospective observational study conducted in the Department of General Medicine at a tertiary care hospital over a period of 12 months at Neelima Medical College, Telangana.

Sample Size

A total of 50 COPD patients fulfilling inclusion criteria were enrolled.

Inclusion Criteria

- Diagnosed COPD patients aged >40 years.
- Clinically stable for at least 4 weeks.
- Able to perform spirometry per ATS guidelines.

Exclusion Criteria

- Acute exacerbation of COPD.
- Chronic kidney disease, liver disease, malabsorption syndromes.
- Current vitamin D supplementation.
- History of disorders affecting bone metabolism.

Data Collection

Demographic and clinical data were recorded.

Serum 25-hydroxy vitamin D measured using chemiluminescence immunoassay.

Vitamin D status was classified as:

Deficient: <20 ng/mL

Insufficient: 20–30 ng/mL

Sufficient: >30 ng/Ml

Spirometry:

- FVC (% predicted) measured using a calibrated spirometer.
- The highest value from three acceptable maneuvers was recorded.

Statistical Analysis

- Mean and SD calculated for quantitative variables.
- Comparison among groups using ANOVA.
- Correlation assessed using Pearson's coefficient.
- $p < 0.05$ considered significant.

Results:

Table 1: Comparison of the Baseline Characteristics of the Study Population

Parameter	Value
Total Participants	50
Mean Age9years)	61.2±9.1
Male: Female Ratio	38:12
Smoking History (%)	72%

Table 2: Distribution of Vitamin D Levels among the Study Population

Category	Vit D(Ng/Ml)	N%
Deficient	<20	32(64%)
Insufficient	20-30	12(24%)
Sufficient	>30	6(12%)

Table 3: Comparison of Fvc Levels among the Study Population

Vitamin D Status	Mean Fvc (% Predicted)	Sd
Deficient	56.8	9.4
Insufficient	63.2	8.1
Sufficient	70.1	7.3

Anova p-value: <0.01 (statistically significant)

Discussion

In this prospective study, a significant association was observed between serum vitamin D levels and Forced Vital Capacity (FVC) among COPD patients. Two-thirds (64%) of the study population exhibited vitamin D deficiency, consistent with the high prevalence of hypovitaminosis D reported in COPD across various populations. Patients with vitamin D deficiency demonstrated markedly lower mean FVC values compared to insufficient and sufficient groups, highlighting the potential role of vitamin D in maintaining pulmonary function.

The positive correlation identified between serum vitamin D and FVC ($r = 0.52$, $p = 0.001$) supports the hypothesis that vitamin D influences respiratory muscle strength and modulates inflammatory pathways that are central to COPD pathophysiology. Vitamin D's immunomodulatory effects—including the reduction of pro-inflammatory cytokines and enhancement of innate immune responses—may contribute to improved lung mechanics and reduced airway remodelling. Additionally, vitamin D is known to enhance skeletal muscle function, and its deficiency may exacerbate respiratory muscle weakness commonly noted in COPD patients. Janssens et al. (2010) reported that vitamin D deficiency was highly prevalent in COPD and was associated with lower FEV_1 and FVC values.

Their study concluded that vitamin D levels dropped proportionally with increasing COPD severity, aligning with the current study's observation of reduced FVC among deficient subjects. Black and Scragg (2005) found a positive association between serum 25(OH) D concentrations and spirometry measures (FEV_1 and FVC) in the general population.

This parallels the correlation found in the present study. Kunisaki et al. (2012), in a randomized trial, observed that vitamin D supplementation reduced exacerbation risk primarily in patients who were vitamin D deficient. Although their primary outcome was exacerbation frequency, their results indirectly support the physiological importance of vitamin D in COPD management. Abraham et al. (2019) conducted a study in South India and reported that lower vitamin D levels were significantly associated with reduced lung function parameters, including FVC.

Similar to the present findings, they emphasized widespread vitamin D deficiency among Indian COPD patients. Zhou et al. (2018) also found that COPD patients with vitamin D deficiency had more severe airflow limitation and poorer spirometry values. This further corroborates the relationship between hypovitaminosis D and impaired lung function. The present study reinforces the growing evidence that vitamin D plays an important role in pulmonary physiology, particularly among individuals with COPD. In addition to the findings already highlighted, the high prevalence of vitamin D deficiency in this study population underscores the need for routine screening, especially in regions with limited sunlight exposure or cultural practices that reduce dermal vitamin D synthesis. Low vitamin D levels may contribute not only to impaired lung function but also to systemic manifestations of COPD such as muscle weakness, increased susceptibility to infections, and reduced exercise tolerance. These systemic effects may collectively contribute to lower FVC values observed in deficient individuals.

Furthermore, vitamin D's anti-inflammatory properties may help mitigate chronic airway inflammation and structural remodelling that are characteristic of COPD. Some researchers have proposed that vitamin D might modulate airway smooth muscle proliferation, oxidative stress, and immune dysregulation—mechanisms that could directly influence spirometry outcomes. The consistency of the current study's findings with international literature suggests that addressing vitamin D deficiency could serve as an important adjunct in comprehensive COPD management. Nonetheless, interventional trials are needed to determine whether correcting vitamin D deficiency leads to sustained improvements in lung function parameters such as FVC.

Conclusion

This study demonstrates a significant positive association between serum vitamin D levels and Forced Vital Capacity in COPD patients. Vitamin D deficiency was highly prevalent in the study population and was associated with substantially lower FVC values.

These findings suggest that screening for and correcting vitamin D deficiency may serve as a simple and cost-effective adjunctive strategy to improve pulmonary function and overall clinical

outcomes in COPD. Further large-scale, randomized controlled trials are warranted to confirm the benefits of vitamin D supplementation in this population.

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