ORIGINAL RESEARCH

A Study on the Relationship between Serum Vitamin D Level and FEV1 in patients with Chronic Obstructive Pulmonary Disease in a Tertiary Care Hospital in India

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is one of the major causes of disability and fatality in the world along with posing a huge social and economic burden. World health organization estimated that COPD had been the cause of death in more than 3 million people around the globe. COPD is associated with significant and progressive irreversible airflow obstruction characterized by narrowing of the airways. Tobacco smoking has been observed to be the most common risk factor for COPD, with indoor air pollution, occupational dusts and chemicals adding on to the list of risk factors. On the other hand, Vitamin D been observed to play an important role in many of the biological processes including the respiratory process wherein, higher vitamin D concentrations have been associated with better lung function. Owing to the immune and anti-inflammatory functions on respiratory epithelium, role in lung tissue remodeling of vitamin D, and an observed deficiency of Vitamin D in patients with COPD, there could be a potential relationship between the two. Aims and Objectives- To evaluate the mean Vitamin D level according to COPD disease severity category as per GOLD criteria, to examine the relationship between serum Vitamin D levels and FEV1 at a sub-population level by categorizing the subjects based on gender, age, smoking status and BMI.

Materials and Methods: This cross-sectional study was designed that included 111 clinically and hemodynamically stable patients with COPD in the Department of Pulmonary Medicine in a Government General Hospital, Kurnool Medical College, Kurnool from Jan 2021 to Dec 2021.The data collected form these assessments were corelated to other factors such as age, gender, BMI and smoking history. On the other hand, a subgroup analysis was performed comparing the genders, age categories, obesity and smoking status.

Results: In our study among 111 subjects where in COPD and vitamin D levels were corelated, showed that the subjects had a lower mean vitamin D level, especially in the severe stages. On similar lines, it was observed that the subjects with higher levels of Vitamin D had decreased number of hospitalizations and vice versa.

Conclusion: These results demonstrate that serum Vitamin D deficiency is present in most of the COPD subjects, with a positive correlation between serum vitamin D levels and post bronchodilator FEV1 volumes. On the other hand, deficiency of Vitamin D was observed to more prevalent in the subjects with severe COPD with the serum vitamin D levels being decreased with the increasing COPD stage. Additionally, higher

frequency of hospitalizations was associated with reduced vitamin D levels. On the contrary, gender, BMI, smoking status and age did not pose any effect on the vitamin D levels.

Keywords: Chronic Obstructive Pulmonary Disease (COPD), Global Initiative for Obstructive Lung Disease (GOLD), American Thoracic Society/European Respiratory Society (ATS/ERS), Forced expiratory volume in first second (FEV1).

INTRODUCTION

COPD is defined as a common preventable and treatable disease is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases.[1] Exacerbations and co morbidities contribute to the overall severity in individual patients, owing to which COPD has been one of the major causes of disability and death across the globe which imposes a huge burden on the health infrastructure. COPD is an umbrella term for chronic bronchitis and emphysema and is characterized by neutrophil and macrophage-induced inflammation over a period of years. Many risk factors such as inhouse pollution due to cooking smoke, occupational pollution due to chemicals, have been identified with tobacco smoking being the most common.[2]

It has been the 4th leading cause of deaths with a staggering estimate of 3 million deaths in the year 2005 world wide. However, no sufficient data is available to estimate the prevalence of COPD in India even though the number of COPD cases are at a rise. Additionally, the percentage of COPD mortality is estimated to be highest in the world.[3,4]

COPD is to be considered in patients with dyspnea, chronic cough and sputum production with any of the associated risk factors as mentioned above. Spirometry is the test of choice to diagnose COPD in the clinical context, owing to its reproducibility and availability. In addition to this, post-bronchodilator FEV1/FVC < 0.70, confirms the presence of COPD as per the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines. Also, the COPD is classified based on the Post Bronchodilator FEV1 as GOLD1, GOLD2 GOLD3 AND GOLD4.

Vitamin D has been under a lot of research, owing to it role in many biological processes and its implications on a variety of diseases. Also, it has been identified that vitamin D has avital role in several chronic diseases including cancer, autoimmune diseases, etc., Additionally higher vitamin D concentrations were observed to be associated with better lung function.[5,6] On similar lines, numerous studies are underway to establish the association between vitamin D and respiratory conditions, especially the chronic diseases. Also, it has been observed that patients with COPD have a higher prevalence of Vitamin D deficiency.[7,8] On similar lines, there could be a reasonable relationship between vitamin D and lung function in patients with COPD.

Aims and Objectives

A cross sectional study was designed to evaluate the relationship between total Vitamin D level (25 OH D) and severity of airflow limitation as measured by post bronchodilator FEV1 value on spirometry in patients with COPD. This study was designed with the following objectives:

1. To evaluate the mean Vitamin D level according to COPD disease severity category as per GOLD criteria.
2. To examine the relationship between serum Vitamin D levels and FEV1 at a sub-population level by categorizing the subjects based on gender, age, smoking status and BMI.

MATERIALS & METHODS

This cross-sectional study was designed that included 111 clinically and hemodynamically stable patients with COPD in the Department of Pulmonary Medicine in a Government General Hospital, Kurnool Medical College, Kurnool from Jan 2021 to Dec 2021. The subjects recruited onto the study were categorized at levels based on the following factors:

1. Smoking status: Current Smoker (at least ≥10 Pack year in their lifetime and who, at the time of survey, smoked either every day or some days), Non-Smoker (never smoked cigarettes or < 10 pack year) and Former Smoker (at least ≥10 Pack year in their lifetime and who, at the time of the survey, did not smoke at all)
2. Vitamin D levels: Severe deficiency (≤ 10 ng/ml), Deficiency (> 10 to ≤ 30 ng/ml) and Sufficiency (> 30 ng/ml)

Medical history of all these subjects was obtained along with performing a systemic examination. Apart from this, spirometry was done for all the subjects as per ATS/ERS guidelines. Also, post bronchodilator FEV1/FVC ratio <0.7 and severity of disease was staged by post bronchodilator FEV1 expressed as percentage predicted according to the latest GOLD classification.

With respect to the vitamin D levels, serum total Vitamin D levels that include Vitamin D3 (25-OH) and Vitamin D2 (25-OH) was assessed.

Inclusion Criteria

1. Both male and female patients presenting with history of COPD
2. ≥ 30 years of age.
3. Previous spirometry reports confirming COPD if available (FEV1/FVC < 0.70)
4. Physician diagnosed COPD(clinical symptoms + FEV1/FVC < 0.70)
5. Patients with non-sedentarylifestyle (ambulatory, working at office or at home, able to do activities of daily living)

Exclusion Criteria

1. Patients diagnosed with asthma based on history (of symptom pattern and medication response), Pulmonary Function Test (showing reversible airway obstruction) or physician diagnosed asthma will be excluded
2. Breathing difficulties of cardiovascular origin (including myocardial infarction, congestive heart failure)
3. Breathing difficulties of other origin, secondary to previously existing intrinsic pulmonary disease including smoke or toxic gas inhalation or foreign body aspiration
4. Patients on Vitamin D supplementation
5. Patients with Chronic Renal failure (Creatinine > 1.5 mg/dl, estimated Creatinine clearance < 20 mg/dl) or, chronic hepatic disease
6. Patients with diagnosed as Primary carcinoma of the lung or secondaries lung
7. Patients with diagnosed Bronchiectasis, Pulmonary TB, Sarcoidosis or ILD
8. Medically unstable patient or patients with acute exacerbation of COPD till become clinically and hemodynamically stable and comfortable at their baseline clinical state
9. Patient with recent Myocardial Infarction or angina
10. Pregnant patients
11. Patients with sedentary life (no or irregular physical activity/ wheelchair bound)

RESULTS

The subjects enrolled in the study were distributed across various age groups as in Table.1 with 87 males and 24 females. Also, the subjects had varied occupations ranging from running their own business, house maker, IT professional, etc.

The smoking status of the subjects revealed that there were 35 non-smokers, 31 former smokers and 45 current smokers as per the criteria mentioned above.

Table 1: ?

Age (years)	Frequency(n)	Percent
30 - 40	12	10.81%
40 - 50	11	9.91%
50 - 60	30	27.03%
60 - 70	36	32.43%
70 - 80	18	16.22%
> 80	4	3.60%
Total	111	100%

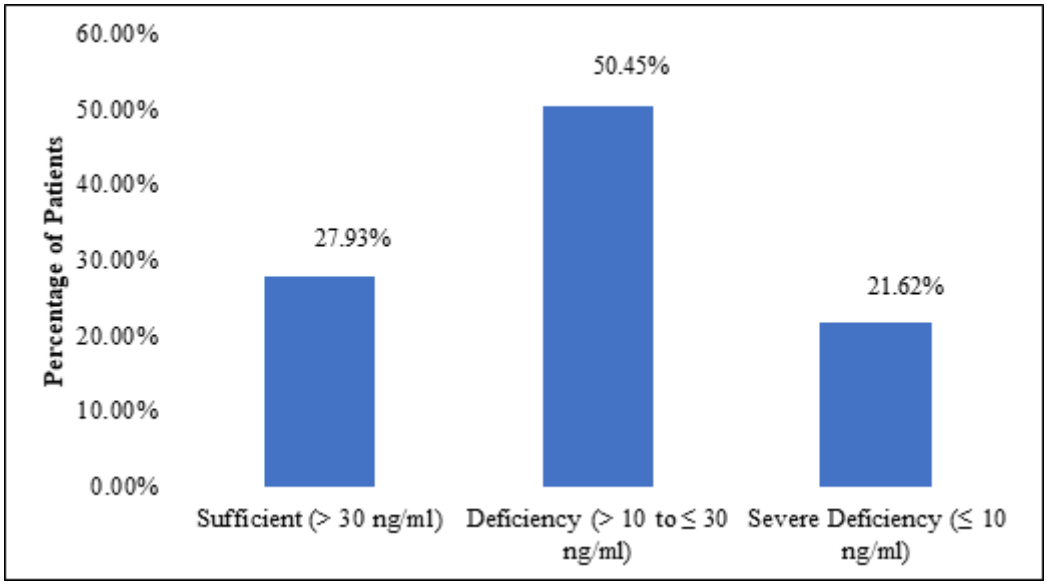

Figure 1: Vitamin D status

The vitamin D levels were assessed as planned and the distribution of the deficiency status is as depicted in [Figure 1]

Table 2: ?

COPDGOLD staging	No of Subjects	Percent
GOLD 1	4	3.61%
GOLD 2	35	31.53%
GOLD 3	46	41.44%
GOLD 4	26	23.42%
Total	111	

Additionally, the lung function which was assessed by means of spirometry were classified as per GOLD guidelines as in [Table2].

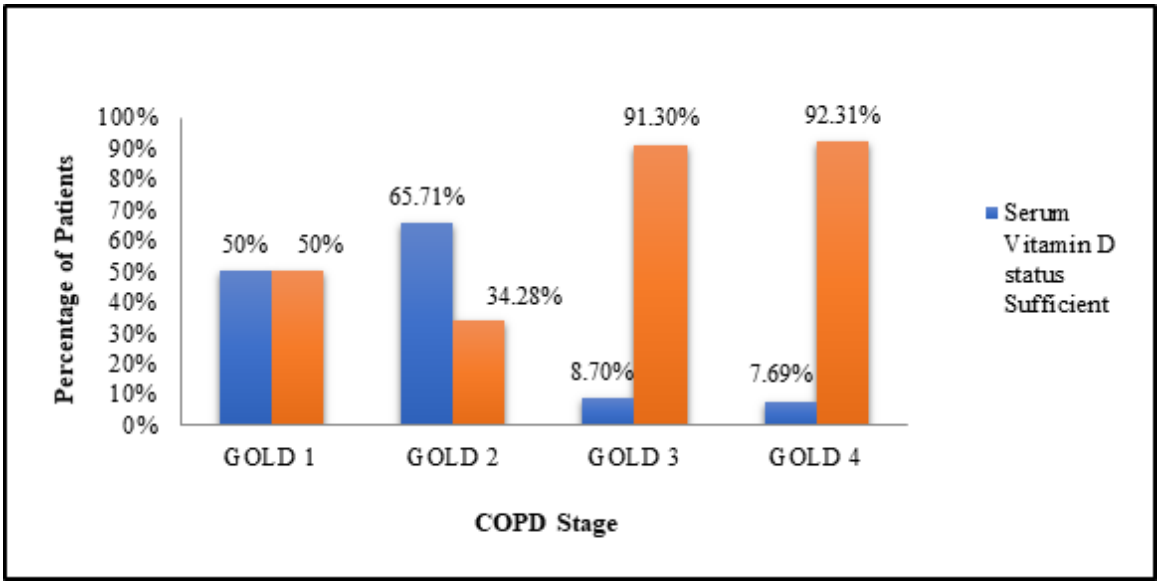

Figure 2: Vitamin D vs COPD stage

An analysis of the correlation between Vitamin D and the COPD staging showed that the vitamin D deficiency was more prevalent in the higher stage of COPD as in [Figure 2].
An additional analysis of the same, showed that the mean FEV1 levels are directly corelated to serum Vitamin D levels where the mean FEV1 values increased from 0.78 ± 0.28L in patients with mean serum 25-OHD 7.30 ng/ml to 1.08±0.44 L in COPD patients with mean serum 25-OHD 18.01 ng/ml to 1.55± 0.61 L in COPD patients with mean serum 25-OHD 36.18 ng/ml

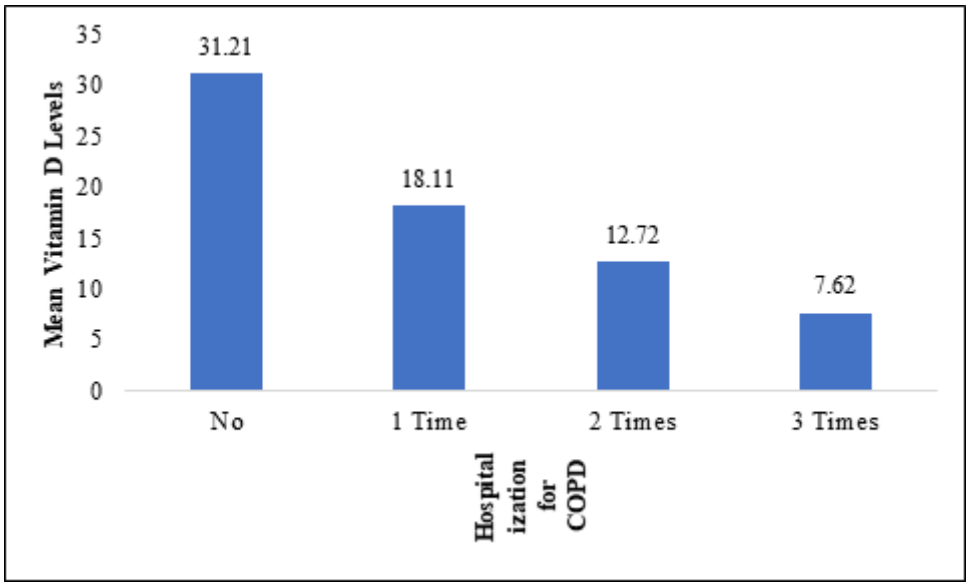

Figure 3: Hospitalization Vs Mean of Vitamin D Levels

Also, the number of hospitalizations were also corelated to the serum Vitamin D levels as in [Figure 3].
On the other hand, higher vitamin D deficiency was observed in subjects with age of >50 years, with this being more prevalent in the female subjects. It was also observed that irrespective of the gender, the vitamin D levels decrease in higher COPD stages, with no significant relationship to the smoking.

DISCUSSION

There is ever-increasing evidence on the role of Vitamin D in various biological processes in regulation of host defense, inflammation, immunity, and repair. Similarly, several respiratory disorders that are mostly inflammatory in nature could be attributed to the activities of Vitamin D.[9] Also, patients with COPD could be at higher risk of vitamin D deficiency owing to various factors.[10] Epidemiological data also suggests that airway inflammation is recognized as a central process in the pathogenesis of COPD and it was clear that the degree of airways reactivity was inversely proportional to the FEV1 in people with airways obstruction.[11]

The present study focuses to assess the relationship between serum vitamin D level and FEV1 in COPD patients and demonstrate that vitamin D deficiency, as assessed by 25-OHD levels in serum, is common in patients with COPD and correlates with the severity of disease as measured by FEV1. The age distribution of this study nearly identical of the study done by Dr.Monadi M, et al,[12] where they conducted the similar study on 80 COPD patients of mean age 67.4 years ±11.5 but all patients were male. Even though the results were not significant; it indicated a trend toward higher improvement of FEV1 at greater concentrations of serum 25-OHD.

Janssens W. et al. in 2010 conducted an analysis to corelate vitamin D deficiency among GOLD STAGES 1, 2, 3 and 4 respectively and he concluded that vitamin D deficiency becomes more common as COPD GOLD stages become higher.[10] Another study carried out by Louise J.P. Persson et al. found higher GOLD stage associated with significantly lower levels of serum 25(OH) D.[13]

CONCLUSION

This study assesses the relationship between serum vitamin D levels and FEV1 in subjects with COPD. With varied results obtained and in correlation of the current study with previously performed studies, the following conclusions were drawn:

- Serum vitamin D (25-OHD) deficiency is present in majority (72.07%) of the study population.
- There appears to be a positive correlation between serum vitamin D (25-OHD) level and post bronchodilator FEV1 (L) volumes.
- The mean FEV1 volume (L) was found to decrease as vitamin D level decreases.
- Vitamin D deficiency was found to be more prevalent among patients with higher COPD GOLD stages.
- Serum mean vitamin D (25-OHD) levels were found to be decreased with increasing COPD GOLD stages.
- Patients with low serum vitamin D level had higher frequency of hospitalization due to COPD. Patients, who were never hospitalized for COPD exacerbation, had a higher mean value of serum vitamin D.
- Serum vitamin D deficiency appeared to be more prevalent in patients > 50 years as compared to those ≤ 50 years (73.86% versus 65.22%).
- Frequency of vitamin D deficiency was high with higher stages of COPD, both in smokers and in non-smokers.
- Prevalence of serum vitamin D deficiency was found to be slightly higher among the obese (73.91%) than the non-obese (71.59%) groups patients. (p= 0.000002, significant).

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