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Original Research Article

Prevalence of vitamin D deficiency in chronic obstructive pulmonary disease and it's correlation with forced expiratory volume in one second: a tertiary care centre study

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ABSTRACT

Background: Vitamin D deficiency is common all over the Indian subcontinent, with a prevalence of 70-100% in the general population. Vitamin D deficiency has a role in several diseases of the respiratory system including chronic obstructive pulmonary disease (COPD). Studies have shown that vitamin D deficient COPD patients have lower lung function measured by FEV_1. We conducted a study to see prevalence of Vitamin D deficiency in COPD patients and it's correlation with Forced Expiratory Volume in 1 second.
Methods: A cross sectional observational study was performed in a tertiary care hospital in Hyderabad, Telangana during the period of one and half year. This included 104 COPD cases attending outpatient department of pulmonary medicine. Serum vitamin D levels were measured, and spirometry was done in all patients and data was analyzed accordingly.
Results: Among 104 patients, 87 were males and 17 were females. Most of the study population (44.2%) was aged between 60-70 years. Mean BMI was 26.40 (±5.77) kg/m^2. Majority of study populations (66.34%) were in GOLD stage 1 and 2. The mean Vitamin D value of the study population was 20.77±11.74ng/ml. Majority of the COPD patients were vitamin D deficient (69.2%). 25.0 % was severely deficient of vitamin D. The mean FEV1 volume (%) was 83.15±11.53, 60.97±17.47, 30.71±7.96 in sufficient, deficient and severe deficient patients.
Conclusions: Vitamin D deficiency is common in COPD patients. Serum vitamin D deficiency increases with increased severity of COPD. There is positive correlation between serum vitamin D levels and post bronchodilator FEV1 (%).

Keywords: COPD, FEV1, Vitamin D

INTRODUCTION

Elmer McCollum identified an antirachitic substance found in certain fats that could prevent rickets. Because the newly discovered substance was the fourth vitamin identified, it was called vitamin D.[1] Vitamin D deficiency is common all over the Indian subcontinent, with a prevalence of 70-100% in the general population because widely consumed food items such as dairy products are rarely fortified with vitamin D. vitamin D deficiency is defined as 25 (OH)D levels <20ng/mL, insufficiency as 20-29ng/mL and sufficiency as ≥30ng/mL.[2] Vitamin D is important for the prevention of rickets in children, type 1 diabetes mellitus, hypertension, and many common cancers in adults.[3] Recently, research has found that vitamin D may play a role in multiple chronic diseases such as cancer, autoimmune diseases, infections, and

cardiovascular disorders.[4,5] Vitamin D may also have a role in several diseases involving the respiratory system including Bronchial asthma, chronic obstructive pulmonary disease (COPD), cystic fibrosis (CF), and respiratory infections. Higher vitamin D concentrations have been associated with better lung function as measured by forced expiratory volume in 1 s (FEV1) in a large cross-sectional study of the U.S. population in the NHANES III.[6]

Although the precise connection between vitamin D status and lung function is unclear at this point, the mechanism by which vitamin D improves lung function may be through its action on regulating inflammation, inducing antimicrobial peptides and its action on respiratory muscles.[7-12] A large cross-sectional study has shown that vitamin D intakes and serum levels are associated with better lung function in adults and similar findings have been reported in adolescents.[6,13] Recently, a number of studies have shown an association between vitamin D deficiency and severity of COPD.[14,15] Lower vitamin D status in COPD may be due to diminished production of pre-vitamin D3 associated with increased skin aging, induced by smoking and reduced sun exposure due to less outdoor activity.[5,16] Studies have shown that the degree of vitamin D deficiency correlates with the severity of the disease as measured by the reduction of FEV1.[6,14,15] However not much literature is available regarding prevalence of vitamin D deficiency in COPD patients in south India which is a treatable component of this particular disease. Hence, we conducted a study to observe the prevalence of vitamin D deficiency in COPD patients and its correlation with FEV_1.

METHODS

This cross sectional observational study was performed in the Department of Pulmonary Medicine in association with Department of Biochemistry, Nizam's Institute of Medical Sciences (NIMS), Hyderabad, Telangana.

Inclusion criteria

Age 35 years or more with history suggestive of COPD and spirometry confirmed diagnosis of COPD as per GOLD criteria (post bronchodilator FEV1/FVC <70%) were included.

Exclusion criteria

- Current or past diagnosis of asthma (defined as an increase in FEV1 >12% and >200ml above the baseline value after administration of a bronchodilator).
- All patients with insufficient mental capacity that preclude obtaining an informed Consent from them.
- Patients are excluded if they have TB, active cancer, diabetes, hypertension, CAD, CKD and liver failure.
- Patients who are on oral glucocorticoid therapy.

Total 104 stable COPD patients were recruited from 1st January 2015 to 30th June 2016 who met our inclusion and exclusion criteria. A detailed history of patient was taken and physical examination of each case was done. Body mass index (BMI) calculation, dyspnoea scoring according to modified medical research council (mMRC), 6 minute walk test was done. Hemogram, Serum vitamin D levels, Renal function tests, Liver function tests, Chest radiograph were done. Additional investigations done depending on the patient's requirement.

Statistical analysis

SPSS statistics 17.0 version was used for data analysis. Results were given as mean ± SD for data with normal distribution and variables that are not normally distributed will log-transformed (median and interquartile range [IQR]). The between-group differences calculated using a two-sided paired t-test or Chi-squared statistic where appropriate. To analyse relationships between variables, Student t test and simple regression performed. A p-value <0.05 was considered statistically significant.

RESULTS

This is a cross sectional observational study conducted between 1st January 2015 and 30th June 2016 i.e. for a period of one and half year. During this period, total 104 patients were included in this study who met the inclusion and exclusion criteria as per the study protocol.

Table 1: Age distribution of the study population.

Age (years)	Frequency (n)	Percentage
30-40	2	1.90%
40-50	10	9.61%
50-60	28	26.92%
60-70	46	44.2%
70-80	16	15.3%
>80	2	1.90%
Total	104	100%

Table 2: Gender distribution of study population.

Gender	Frequency (n)	Percentage
Male	87	83.6%
Female	17	16.4%
Total	104	100%

Table 3: distribution of study population as per GOLD stages.

GOLD stage	Frequency (n)	Percentage
GOLD 1	30	28.8%
GOLD 2	39	37.5%
GOLD 3	21	20.1%
GOLD 4	14	13.4%
Total	104	100%

Table 4: Serum vitamin D status of the study population.

Vitamin D status	Frequency	%
Sufficient (> 30 ng/ml)	32	30.7
Deficiency (>10 to ≤30ng/ml)	42	44.2
Severe Deficiency (≤10ng/ml)	26	25.0
Total	104	100

Age is ranged from 38 years to 91 years. Most of the patients were in age group between 60-70 years. About 60% patients were aged >60 year.

Among study population 87 participants were males (83.6%), 17 participants were females (16.4%). Majority of study populations were in stage GOLD 1 and GOLD 2 COPD as per GOLD classification (66.34%).33% of patients were in GOLD stage 3 and 4.

The mean Vitamin D value of the study population was 20.77ng/ml (±11.74). Minimum vitamin D level was 5.6ng/ml and maximum value were 43.9ng/ml. Majority of the COPD patients were vitamin D deficient (69.2%). 25.0% was severely deficient of vitamin D.

Table 5: Serum vitamin D deficiency (%) status in various COPD stages (categorized vitamin D deficient = deficiency + severe deficiency).

Serum Vitamin D status		
COPD stage	Sufficient	Deficient (deficiency +severe deficiency)
GOLD 1 (30)	21 (70.0%)	9 (30.0%)
GOLD 2 (39)	5 (12.8%)	34 (87.2%)
GOLD 3 (20)	0 (0%)	20 (100%)
GOLD 4 (14)	0 (0%)	14 (100%)

Table 6: Post bronchodilator FEV1 (%) with serum Vitamin D (ng/ml) value.

Vitamin D status	Post BD FEV1 (%)	
	Mean FEV1 (%)	SD
Sufficient	83.15	11.53
Deficiency	60.97	17.47
Severe deficiency	30.71	7.96

In stage 1 COPD (as per GOLD), 30% patients had vitamin D deficiency. In stage 2 COPD, 87.2% patients had vitamin D deficiency in stage 3 and stage 4 COPD, 100% patients were vitamin D deficient (P<0.01) (Table 5). The mean FEV_1 volume (%) decreases as the degree of vitamin D deficiency increases. The mean FEV_1 volume (%) was 83.15±11.53, 60.97±17.47, 30.71±7.96 in sufficient, deficient and severe deficient patients.

DISCUSSION

In this single institution based, observational cross-sectional study, conducted for one and half year time period, and recruited 104 stable COPD patients. Age ranged from 38 years to 91 years. Most of the study population 64 (60.0%) was above 60 years of age where 87 (83.6%) patients were male and 17(16.4%) participants were female. (Table 1 and 2). Majority of study populations were in stage GOLD 1 and GOLD 2 COPD as per GOLD classification (66.34%).33% of patients were in GOLD stage 3 and 4 (Table 3).

Mean BMI was 26.40 (±5.77) kg/m^2. Minimum BMI was 14.9kg/m^2 and maximum BMI 36.5kg/m^2. Most of the population had normal BMI within the range of 18.5-25kg/m^2 (49.00%). 7 patients (6.72%) were obese BMI >30kg/m^2.

The mean Vitamin D value of the study population was 20.77ng/ml (±11.74). Minimum vitamin D level was 5.6 ng/ml and maximum value was 43.9ng/ml. Majority of the COPD patients were vitamin D deficient (69.2%). 25.0% were severely deficient of vitamin D (Table 4).

Similar study conducted by Zhang P et al, concluded that prevalence of vitamin D deficiency in the stable COPD group was significantly higher (39.47%) than that in the control group.[17] Gouda E et al, in his study from India showed that 56.7% of patients with COPD had mild to moderate degree of vitamin D deficiency and 43.3% patients of COPD had severe deficiency.[18] Tedd H et al, in their study showed overall 62% of patients were found to have low 25(OH)-D titres.[19]

Mean value of serum vitamin D decreases as GOLD stages become higher. Serum vitamin D values (mean value ±SD) were 30.80±6.87ng/ml, 20.04±7.00ng/ml, 14.00±4.27ng/ml, 10.50±5.38ng/ml in GOLD stage 1,2,3,4 respectively (P<0.01).

Our study showed that severity of vitamin D deficiency in stable COPD patients increase as the disease severity progresses. Prevalence of serum vitamin D deficiency in GOLD stage 1 was 30%, stage 2 was 87.5%, stage 3 and 4 was 100% (Table 5). When compared to other studies, our study has higher prevalence of vitamin D deficiency. Similar analysis was done by Janssens W et al, in 2010 showed 39%, 47%, 60% and 77% of patients deficient of vitamin D 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.[14]

Higher COPD stage patients had high prevalence of vitamin D deficiency as they are more likely to stay indoors, have longer smoking history, anorectic, and take oral glucocorticoids, which reduce the levels of vitamin D. The mean FEV_1 volume (%) decreases as the degree of vitamin D deficiency increases.[20] The meanFEV_1 volume (%) were 83.15±11.53, 60.97±17.47, 30.71±7.96 insufficient, deficient and severe deficient patients (Table 6). Similar study by Mohanta PC et al, correlated the serum vitamin D level and FEV1% of predicted in stable COPD patients.[21] In 25OHD deficiency COPD cases

FEV1% of predicted was 28.10±6.17, in 25-OHD insufficiency cases was 35.92±8.03 and sufficiency case was 46.10±11.99.

There was very strong positive correlation present between, serum 25-OHD and FEV1 % of predicted in stable COPD. Similarly, Monandi M et al, measured the Serum 25-hydroxyvitamin D (25-OHD) and post bronchodilator forced expiratory volume in 1s (FEV1).[22] The mean FEV1 volume in serum vitamin D deficient COPD patients was lower than sufficient COPD patients (1.550±0.55 vs 1.650±-0.58, p=0.45).

CONCLUSION

Vitamin D deficiency is common in COPD patients. Serum vitamin D decreases along with increase severity of COPD. There is significant positive correlation between serum vitamin D (25-OHD) level and post bronchodilator FEV1 (%) volumes, which are a measure of severity of airflow limitation. These findings suggest all the COPD patients should be tested for serum 25-OHD status and appropriate supplementation should be given. However, these findings are required to be confirmed in further studies with a larger sample size.

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