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A Study on Serum Vitamin D Level in Patients Suffering from Various Pulmonary Disorders

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ABSTRACT

Vitamin D is a critical nutrient for human health. However, our environment, lifestyle and genetic makeup can significantly impact the efficacy of vitamin D production in the body. Unfortunately, our diets do not provide us with sufficient vitamin D, leading to a variety of health issues. Vitamin D also has a pivotal role in the development of pulmonary diseases. Hence this study was done to estimate vitamin D levels in patients suffering from various pulmonary disorders. This is a cross-sectional type of study conducted at a tertiary care centre with a sample size of 160 consisting of 80 cases of respiratory diseases with 80 apparently healthy attendees for a period of 1 year. We found that vitamin D levels were deficient (16.95ng/ml) in pulmonary disease patients as compared to their apparently healthy attendees(20.69). Patients with infective aetiology i.e., Tuberculosis, community-acquired pneumonia, and bronchiectasis had a much lower value of vitamin D (10.72 ng/ml) as compared to other patients with non-infective aetiology (19.43 ng/ml). Our study shows an inverse relationship between blood vitamin D levels and Body Mass Index and found direct association with occupation and smoking history. However, no link was discovered with gender or geography. This study's findings add to the growing body of information on the factors related to vitamin D status.

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Introduction

Vitamin D is a critical nutrient for human health primarily obtained through sunlight exposure. However, our environment, lifestyle and genetic makeup can significantly impact the efficacy of vitamin D production in the body [1]. Unfortunately, our diets do not provide us with sufficient vitamin D, leading to a variety of health issues associated with vitamin D deficiency such as rickets and osteomalacia. Recently, studies have suggested that higher vitamin D levels may also be associated with certain diseases. Shockingly, vitamin D deficiency rates can be alarmingly high, ranging from 84.9% to 100% among school-aged children and 30% to 91.2% among adults [2,3].

Deficiencies in vitamin D have been linked to the severity of asthma, chronic obstructive pulmonary disease (COPD), interstitial lung disease, pulmonary infections and lung cancer. The active form of vitamin D produced by bronchial epithelium and immune cells in our body modulates various parameters within the vitamin D axis in response to stimuli such as cytokines and toll-like receptor ligands [4-6].

Vitamin D aids in the control of cell proliferation and differentiation, the prevention of lung cancer and the regulation of immunological function. It boosts our innate immunity by encouraging early microbial protection and increasing autophagy. It also regulates T-cell responses while controlling gene expression in white blood cells and promoting the generation of anti-inflammatory cytokines. Finally, vitamin D regulates immunological responses to bronchial assaults by fostering balanced interactions between different cell lines [7-9].

This paper highlights the importance of vitamin D in respiratory health and demonstrates the many ways in which vitamin D deficiency can negatively impact our immune system and overall health. It is crucial for individuals to be aware of the factors that can influence their vitamin D levels and to take measures to ensure they are getting enough of this vital nutrient.

Material and Methods

The study has been conducted under the authorization of the Ethic Committee of King George's Medical University, Lucknow, Uttar Pradesh, India with document no.74. in the Department of Respiratory Medicine, from 1st May 2019 to 30th April 2020. The study included patients with respiratory disorders who presented to outpatient and inpatient clinics, while apparently healthy attendants of enrolled patients were taken as controls. Patients who failed to provide consent and had other comorbidities, or had a history of intake of vitamin D or calcium in the past month were excluded from the study.

After obtaining written informed consent from the participants, complete medical history and comprehensive examinations were performed. Two millilitres of venous blood were collected and centrifuged to separate the serum, which was stored at -20 degrees Celsius until the time of assay. Serum levels of 25-hydroxyvitamin D were quantified using a chemiluminescent microparticle immunoassay (CMIA) method and categorized into sufficient (>30ng/ml), insufficient (21-29ng/ml), and deficient (<20 ng/ml).

Results

In this study, we enrolled 80 cases and 80 controls are all apparently healthy attendees. The mean age of our study population was 47.08 +/-17.34 years. Baseline demographic, clinical, and biochemical features were recorded. We found that vitamin D levels were deficient (16.95ng/ml) in pulmonary disease patients as compared to their apparently healthy attendees (20.69) (Table 1). The majority of the study population was male. Although females had a lower mean vitamin D3 level (18.52 ng/ml) compared to males (21.79 ng/ml), the association between gender and vitamin D3 level was non-significant.

Table1: Comparison of S.VIT D3 (ng/ml) in between Study Group and Control Group

	Study Group (n=80)		Control Group (n=80)		[1]p-Value
	Mean	±SD	Mean	±SD	
S.VIT D3 (ng/ml)	16.95	9.38	20.69	8.11	0.008*

SD=Standard deviation, 1=Independent t-test, *=Significant ($p<0.05$)

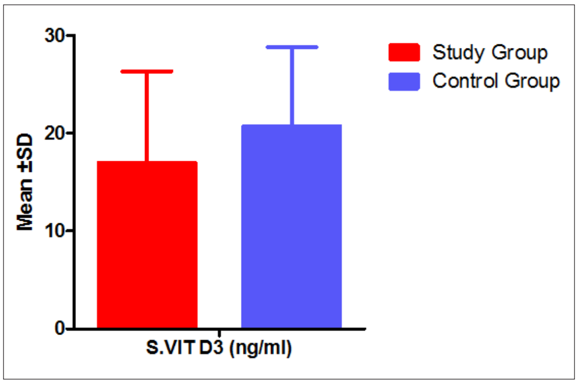

Table 1: shows comparison of S.VIT D3 (ng/ml) in between study group and control group.Serum vitamin D3 level was less in study group(16.95ng/ml) as compared to control group(20.69ng/ml)

The mean Body Mass Index (BMI) among the study group was less (23.81) compared to the control group (30.73) and an inverse relationship was observed between serum vitamin D level and BMI. Subjects with higher BMI had lower serum vitamin D levels than those with normal/low BMI. (Table 2)

Table2: Association of Serum Vitamin D3 With BMI among People in Study Group

	BMI <25 kg/m² (n=47)		BMI ≥25 kg/m² (n=33)		[1]p-Value
	Mean	±SD	Mean	±SD	
S. Vit D3 (ng/ml)	17.03	11.34	16.84	5.73	0.930

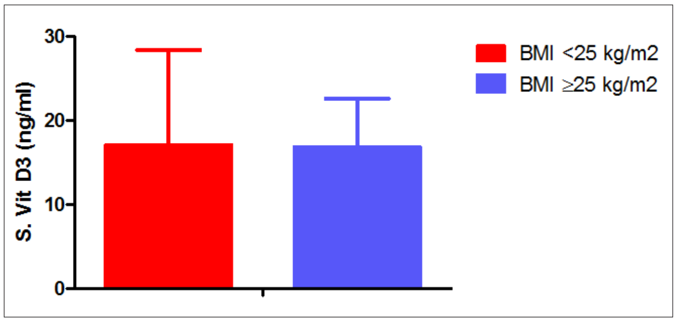

Table 2: shows Association of serum vitamin D3 level with BMI among study group. patients with BMI(>25kg/m^2) had a lower vitamin D3 level (16.84 ng/ml) as compared to the ones with normal to low BMI (17.03).

Regarding location, the number of patients from rural areas was higher than urban areas in both groups. However, no significant association was observed between serum vitamin D3 levels and location.

The occupation was also considered, and it was found that subjects with indoor occupations had lower serum vitamin D3 levels than those with outdoor occupations. (Table 3)

Table3: Association of Serum Vitamin D3 with Indoor/Outdoor Occupation among People in Study Group

	Indoor Occupation (n=42)		Outdoor Occupation (n=38)		p-Value
S. Vit D3 (ng/ml)	11.11	11.39	11.48	6.66	0.835

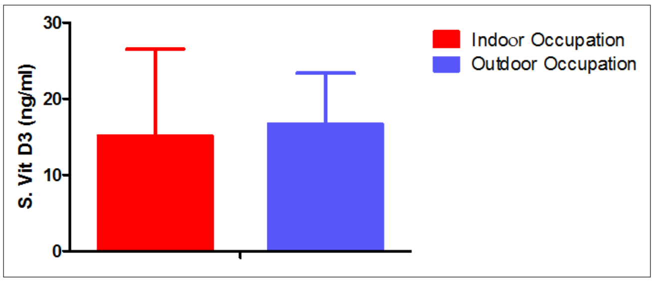

Table 3: shows association of serum vitamin D3 level with Indoor/outdoor Occupation among patients in study group. patients with indoor occupation had a lower serum vitamin D3 level as compared to patients of outdoor occupation showing that a less exposure to sunlight is one of the reasons for lower serum vitamin D levels

Smoking history was also examined and patients who were smokers/ex-smokers had lower mean serum vitamin D levels (16.70 ng/ml) than non-smokers (17.21 ng/ml).

Patients with reduced haemoglobin levels (< 11 g/dl) showed lower serum vitamin D levels compared to those with higher haemoglobin levels (>11.9 g/dl).

Patients with infective etiology (bronchiectasis, pneumonia, tuberculosis) showed a lower mean vit D3 level (=10) as compared to patients with non-infective etiology (19.43 ng/ml) (Table 4 and Figure 4a)

Table 4: S.VIT D3 (ng/ml) Level in Diagnosed Diseased Patients

S.No.	n	Diagnosis	S. Vit D3 (ng/ml)	
			Mean	±SD
1	10	COPD	18.68	4.83
2	13	Bronchial asthma	23.40	16.15
3	13	ILD	19.8	5.12
4	6	Bronchiectasis	10.65	1.00
5	6	Community acquired pneumonia cause pyogenic	10.87	0.92
6	15	Tuberculosis	10.65	1.00
7	12	Lung cancer	16.64	3.77
8	5	Post-TB	18.64	4.71

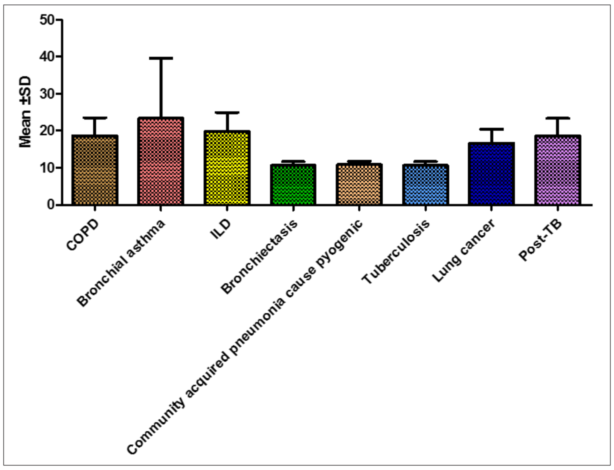

Table 4: shows relative distribution of serum vitamin D3 levels in patients with various pulmonary disorders. Patients with infective etiology (bronchiectasis, pneumonia and tuberculosis) showed a lower mean Vit D3 level (=10) as compared to patients with non-infective etiology`

Figure 4a: Association of S. vit. D3 with Etiology among Patients in Study Group

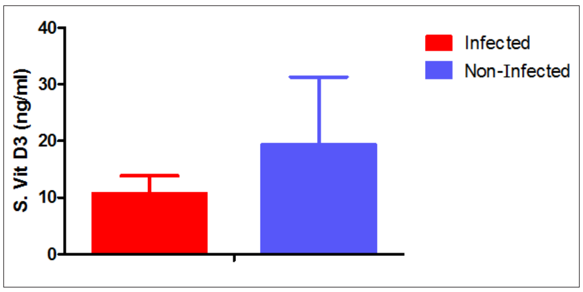

Figure 4a: shows Association of S. vit. D3 with etiology among patients in study group. patients with infective etiology had a lower mean vitamin D level (10.72 ng/ml) as compared to patients with non-infective etiology(19.43 ng/ml)

In summary, our study found an inverse relationship between serum vitamin D levels and BMI and also observed that occupation and smoking history may impact vitamin D levels. However, no significant association was observed between serum vitamin D3 levels and gender or location.

Discussion

The present study aimed to investigate the relationship between serum vitamin levels and demographic, clinical and biochemical factors in apparently healthy individuals. The study found an inverse association between serum vitamin D levels and BMI, which is consistent with previous studies. The underlying mechanism for this association is not fully understood, but it may be due to the sequestration of vitamin D in adipose tissue. Ahmad Mohammad et al. discovered a high frequency of vitamin D deficiency in atopic asthma patients, particularly those with severe asthma [10]. Our study also discovered decreased vitamin D levels in asthma patients, however only in mild to moderate cases. It is crucial to highlight, however, that our study did not include severe asthma patients because the goal was not to investigate asthma severity due to the small sample size. Both studies' findings show that vitamin D deficiency may be common among asthma sufferers. Vitamin D is important for the immune system's response to community-acquired pneumonia (CAP). Because both pathogen infection and immune dysfunction are linked to the development of CAP. Vitamin D deficiency could be a risk factor. Several studies have been conducted to thoroughly study the association between Vitamin D and CAP. Patients with Vitamin D insufficiency were shown to have a considerably elevated risk of CAP in a study conducted by Yun-Fang Zhou et al. Serum Vitamin D3 levels were low in our study group, which included patients with a variety of pulmonary diseases. Also, patients with infectious aetiology such as bronchiectasis, CAP and Tuberculosis (TB) had lower serum Vitamin D3 levels than those with non-infectious aetiology such as COPD, asthma, lung cancer and ILD. (Table no 1) These data imply that Vitamin D may be important in preventing and controlling CAP in people with respiratory diseases [11]. James D Chalmers et al. colleagues examined 25-hydroxyvitamin-D levels in 402 stable patients with bronchiectasis in research [12]. After a three-year period, patients who were vitamin D deficient had great levels of inflammatory markers in their sputum and exhibited a faster loss of lung function. Additionally, those who were lacking in vitamin D were more likely to be persistently colonised with bacteria. These findings imply that a lack of Vitamin D may contribute to the evolution of bronchiectasis and worsen lung inflammation in patients with the illness. As a result, maintaining adequate Vitamin D levels may be critical in controlling bronchiectasis and improving patient outcomes. Kelechi E Nnoaham et al. undertook an observational study to evaluate the link between low serum vitamin D levels and the incidence of active tuberculosis [13]. The study's findings revealed that low serum vitamin D levels were linked to an increased risk of active TB. Our study indicated that tuberculosis patients had a lower serum vitamin D3 level of 10.65 ng/ml compared to control patients who had a mean serum vitamin D level of 20.69 ng/ml. Furthermore, pulmonary tuberculosis patients had a higher mean serum vitamin D level than extrapulmonary tuberculosis patients, and drug-resistant TB patients had the lowest serum vitamin D level. Although more prospective studies are needed to determine the direction of this link, it appears that low vitamin D levels in the body increase the likelihood of active tuberculosis. The active form of vitamin D improves macrophages' ability to restrict Mycobacterium TB intracellular development. In the lack of appropriate serum vitamin D, the generation of microbe-killing cathelicidin is hindered, which can be triggered by molecules of the tubercle bacillus via the toll-like receptors. As a result, maintaining adequate serum vitamin D levels may be critical in preventing and treating active TB [14,15]. Kumar A et al. conducted a prospective observational research that included all patients with COPD. In COPD patients, the mean serum 25 (OH) vitamin D level was 27.8616.47 ng/ml. There was no statistically significant variation in serum 25 (OH) vitamin D levels across patients of different ages. Serum 25 (OH) vitamin D levels differed considerably between GOLD stages and mMRC dyspnea grades. According to the findings, low serum 25(0H) vitamin D levels are associated with greater airway blockage. The majority of the 74 patients were in GOLD stages 2 and 3. Stage 1 patients had the highest mean 25(OH) vitamin D level (59.33 ng/ml). The mean vitamin D level was highest in stage 1 COPD patients, and it declined as severity rose. Mean serum 25 (OH) Vitamin D levels were lower in elderly patients than in younger patients and were associated with GOLD group D versus GOLD group A [16]. In comparison to this study, ours found a mean Vitamin D level of 18.68+/-8.63 in COPD patients compared to the control group (20.69ng/ml). The rationale for not including GOLD staging and severity in our study's goal was a lack of sample size. Serkan Degirmencioglu and their colleagues studied 462 individuals with non-small cell lung cancer (NSCLC) and discovered that serum 25(OH) D levels were considerably lower in adenocarcinoma patients than in squamous-cell carcinoma patients. They also discovered a link between the advanced stage of Non-small cell lung cancer (NSCLC) and lower serum 25(OH)D levels. Similarly, in our study, we found that the mean level of vitamin D in adenocarcinoma was lower (16.62+/-4.23) than in squamous cell carcinoma (17.25+/-2.90) and small cell carcinoma (15.50+/-5.52). Unfortunately, due to the small sample size of our investigation, we were unable to analyse the relationship between serum vitamin D levels and lung cancer stage. Overall, the mean vitamin D level in lung cancer patients in our study agreed with the findings of Degirmencioglu et al [17]. According to a study by Jared T. Hagaman et al, 38% and 59% of patients with connective tissue-associated interstitial lung diseases (CTD-ILD) had vitamin D deficiencies and insufficiencies, respectively. The study also showed a significant correlation between decreased 25-hydroxyvitamin D3 levels and decreased lung function and carbon monoxide diffusing capacity in patients with CTD-ILD [18]. Comparatively, our research revealed that patients with CTD-ILD had lower mean serum vitamin D3 levels than those without the condition. Due to the limitations of our investigation, we were unable to examine the relationship between vitamin D levels and lung function or diffusing capacity. Yet, the results of both investigations point to a possible part played by vitamin D in the development and spread of ILD. Sandhiya Selvarajan et al conducted a comprehensive literature study to determine the range of Vitamin D levels among persons from various regions of India who appeared to be in good health. The mean blood vitamin D level among Indians was 14.16 ng/ml, with a range of 3.15 1.4 to 52.9 33.7 ng/ml (range: 3.15 1.4 to 52.9 33.7 ng/ml) across forty investigations. This shows that Vitamin D deficiency is common among apparently healthy Indians residing in various regions of India, independent of their exposure to sunlight. In comparison to this study, another study showed that in apparently healthy attendees of the patients included in the control group (n=80), the serum vitamin D3 level was in the insufficiency range (21-29 ng/ml). Many of the findings in our study were similar to the above study. Females had lower serum vitamin D3 value as compared to males, and subjects belonging to urban areas had a lower vitamin D3 value as compared to rural populations. Furthermore, the study observed that individuals with indoor occupations had lower serum vitamin D levels than those with outdoor occupations. This is likely due to reduced sun exposure, which is the primary source of vitamin D synthesis in humans. Interestingly, smoking history was associated with lower serum vitamin D levels, which has also been reported in previous studies. Finally, individuals with reduced haemoglobin levels showed lower serum vitamin D levels compared to those with higher haemoglobin levels [19,20]. However, our study did not find a significant relation between serum vitamin D levels and gender or location. The lack of association with gender is inconsistent with some previous studies that have found that females tend to have less vitamin D levels than males. The lack of association with location is also inconsistent with some previous studies that have found that individuals living in urban areas tend to have less vitamin D levels than those living in rural areas. One of the strengths of this study is the relatively large sample size of 80 cases and 80 controls, which increases the generalizability of the findings. Another strength is the inclusion of a range of demographic, clinical, and biochemical factors, which allowed for the exploration of multiple potential factors associated with vitamin D levels. This study has a number of drawbacks. Firstly, the study design is cross-sectional, which limits the establishment of causality. Secondly, the study population was limited to apparently healthy attendees, which may not be indicative of the whole population. Thirdly, the study relied on a single measurement of serum vitamin D levels, which may not reflect the long-term vitamin D status of individuals. Finally, the study did not investigate the potential confounding effects of dietary intake, physical activity, and other lifestyle factors on vitamin D levels.

Conclusion

In conclusion, the current investigation shows an inverse relationship between blood vitamin D levels and BMI, as well as an association between occupation and smoking history and vitamin D levels. However, no link was discovered between serum vitamin D levels and gender or geography. This study's findings add to the growing body of information on the factors related to vitamin D status, and they may have implications for public health initiatives focused on improving vitamin D status in at-risk populations.

We discovered that apparently healthy participants in our study had serum vitamin D3 levels in the insufficiency range. One cause for this among Indians is decreased vitamin D synthesis as a result of darker skin, the use of sunscreen, an indoor lifestyle, lower consumption of vitamin D-rich dietary goods, and so on. Females exhibited lower serum vitamin D3 levels than males. This has been linked to limited exposure to sunlight, poor nutrition, and early marriage and motherhood among girls.

Individuals with tuberculosis, community-acquired pneumonia, and bronchiectasis exhibited significantly lower vitamin D levels than other non-infectious aetiology patients. This suggests that vitamin D may help to reduce inflammation. In patients with various pulmonary diseases, adequate vitamin D levels should be maintained. Vitamin D supplementation should be given to patients with infectious aetiology in order to control the condition and avoid future exacerbations.

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Ethics Approval and Consent to Participate: The study was approved by the Institutional Ethical Committee of King George's Medical University (Ref. code: - 103rd ECM-II B-thesis/P29). The concerned patients proper verbal and written consent was taken before inclusion in the study.

Informed Consent: Written informed consent was obtained from a legally authorized representative(s) for anonymized patient information to be published in this article. The manuscript does not contain any individual person's data in any form.

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