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Original Research Article

Study of Vitamin-D Levels in Chronic Obstructive Pulmonary Disease Patients & Healthy Volunteers

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Abstract

Introduction: Chronic obstructive pulmonary disease (COPD) being the most common non-communicable disease in the world with mortality around 5.4 million per year. Vitamin D being a fat soluble vitamin, is drastically reduced in COPD patients and its prevalence of varies from 31-77%, among COPD patients. The purpose of the study is to bring further more information about vitamin D status among COPD patients.

Methodology: With prior institutional ethical committee approval, a case control study was carried out from February 2018 to June 2019 among 50 COPD cases and 50 controls with age group of more than 40 to 75 years attending the outpatient & inpatient Department of Pulmonary medicine and General medicine, Karpaga Vinayaga Institute of Medical Sciences.

Results: Among the cases (n=50), 15 (30%) participants had vitamin d level between 10 to 19.99, 5 (10%) had between 20 to 29.99 and 30 (60%) had vitamin level >30, Whereas among the controls (n=50), 1 (2%) participant had vitamin d level 10 to 19.99, 5 (10%) had between 20 to 29.99 and 44 (88%) had vitamin d level >30. The difference in the proportion of vitamin d level between study groups was statistically significant (P value 0.001). Vitamin D levels among grade I severity COPD cases is 44.87±8.03, followed by 34.64±9.45 among grade II COPD, 32.73±13.03 among grade III COPD cases and 14.87±1.65 with grade IV severity cases. The vitamin D levels are inversely proportionate with the severity of disease and it is statistically significant. Out of 50 COPD cases, 7(14%) cases had 1-2 exacerbations, 28 (56%) cases had 3-5 exacerbations and 15 cases (30%) had > 5 exacerbations/year and with their mean Vitamin D levels were 39.36, 36.40, 21.05 respectively and is found to be significant with a P- value of 0.001.

Conclusion: The study concludes that Vitamin D hypovitaminosis is common among COPD patients than control group. The severity of Vitamin D hypovitaminosis is directly proportionate with the severity of COPD and number of exacerbations.

Keywords: Chronic Obstructive Pulmonary Disease, Vitamin D, Hypovitaminosis.

Introduction

"Chronic obstructive pulmonary disease (COPD)" being the most common preventable and treatable non-communicable disease in the world contributing to more mortality and morbidity.[1] Being the fourth leading cause of death worldwide, COPD accounted for 3.5 million deaths, roughly 5% of all deaths occurred in 2021[2]. By 2060, estimated COPD mortality will be around 5.4 million per year [2]. COPD is suspected in any patients aged above 40 years with chest symptoms like breathlessness, wheeze, cough, expectoration, chest pain along with strong exposure to risk factors like Smoking, outdoor air pollution, biomass fuel exposure, occupational exposure, environmental tobacco smoke, poorly treated asthma, treated pulmonary tuberculosis, alpha 1 antitrypsin deficiency.[3],[4],[5],[6]. Vitamin D being a fat soluble vitamin, is synthesized from natural sun light through various biochemical reactions in skin and kidney is drastically reduced in COPD patients due to various mechanisms.[7], [8], [9], [10] Among COPD patients prevalence of Vitamin D deficiency varies from 31-77% [11], [12], [13]. Vitamin D deficiency in COPD has been associated with risk of exacerbations and subsequently lead to frequent hospitalization. [14], [15] additionally supplementation of Vitamin D, reduces moderate to severe exacerbations among COPD patients. [16] Though many researches had been done on association of hypovitaminosis D with COPD patients, there is a huge variation in results. The purpose of this study is to bring further

more information in vitamin D status among COPD patients in kanchipuram district.

Aim and Objectives:

1. To compare vitamin- D levels in COPD patients & healthy volunteers.
2. To analyse the level of vitamin-D levels in stable COPD patients & in COPD patients with exacerbations.
3. To analyse the vitamin-D levels according the severity of COPD in patients.

Materials and Methods (Methodology)

With prior institutional ethical committee approval, a case control study was carried out from February 2018 to June 2019 among 50 COPD cases and 50 controls with age group of between 40 to 75 years attending the outpatient & inpatient Department of Pulmonary medicine and General medicine, Karpaga Vinayaga Institute of Medical Sciences.

Inclusion Criteria:

Case: The cases were patients above 40 years and having COPD based on spirometry as per GOLD guidelines

Control: The controls were non-COPD patients and the persons attending regular health checkup who have no known significant medical illness which can affect the outcome of the study.

Exclusion Criteria for Cases & Control:

1. Patients less than 40 years of age
2. Patients taking vitamin D supplementation
3. Patients suffering from diseases which affects Vitamin D and calcium metabolism like Renal dysfunction, Osteomalacia, Malignancy, Thyroid disorders, Parathyroid dysfunction, , Inflammatory bowel diseases, History of small bowel resection, Cholestatic liver disease, Pancreatitis, Cystic fibrosis, Bronchiectasis, Granulomatous disorder.
4. Patient on treatment with drugs like Phenytoin, Phenobarbital, Carbamazepine, Isoniazid, Rifampin, Tenofovir, Efavirenz
5. Patients not willing to take part in the study

Patients who are consenting to participate in the study and fulfilling inclusion & exclusion criteria were subjected to complete history taking, physical examination, spirometry, chest x ray, routine blood investigations & serum Vitamin D level estimation. Vitamin D levels are measured using Chemiluminescence immunoassay (CLIA) and the Biological Reference Interval of Vitamin D3 in adults is 30-100ng/mL. The data were analyzed by using standard Mean deviation, student's T test, % graph to compare the levels of various biochemical parameters in age- categorized male and female patients. P-value of <0.05 was considered as statistically significant.

Results

A case control study was carried out among 50 COPD cases and 50 controls with age group of more than 40 to 75 years attending the outpatient & inpatient Department of Pulmonary medicine and General medicine, Karpaga Vinayaga Institute of Medical Sciences. Out of 50 COPD cases, 32 (64%) participants were male and 18 (36%) participants were female, with mean age of 56.9, and among the 50 controls, 26 (52%) participants were male and 24 (48%) participants were female with mean age of 53.84. In pertain to smoking habits, among the cases (n=50), 31 (62%) participants were smokers, 19 (38%) were non-smokers. Whereas among the controls (n=50), smokers and non-smokers were 23 (46%) and 27 (54%) respectively which is statistically not significant (P value 0.108).

Among the cases (n=50), 15 (30%) participants had vitamin d level between 10 to 19.99, 5 (10%) had between 20 to 29.99 and 30 (60%) had vitamin level >30. And among the controls (n=50), 1 (2%) participant had vitamin d level 10 to 19.99, 5 (10%) had between 20 to 29.99 and 44 (88%) had vitamin d level >30. The difference in the proportion of vitamin d level between study groups was statistically significant (P value 0.001).

Vitamin D levels among grade I severity COPD cases is 44.87±8.03, followed by 34.64±9.45 among grade II COPD, 32.73±13.03 among grade III COPD cases and 14.87±1.65 with grade IV severity cases. The vitamin D levels are inversely proportionate with the severity of disease and it is statistically significant.

Among grade I & II COPD cases (n=17), 2 (12.5%) participants had vitamin d level 20 to 29.99 and 15 (87.5%) participants had >30. And with 33 participants with grade III & IV COPD (n=33), 15 (45.45%) participants had vitamin d level 10 to 19.99, 3 (9.09%) participants had 20 to 29.99 and 15 (45.45%) participants had vitamin d level >30.

Out of 50 COPD cases, 7(14%) cases had 1-2 exacerbations, 28 (56%) cases had 3-5 exacerbations and 15 cases (30%) had > 5 exacerbations/year and with their mean Vitamin D levels were 39.36, 36.40, 21.05 respectively. The difference in vitamin d level between the No. of exacerbations is found to be significant with a P-value of 0.001.

Table 1:

Parameters			Study group		Chi square	P-value
			Cases (N=50)	Controls (N=50)		
Gender		Male	32 (64%)	26 (52%)	1.478	**0.224**
		Female	18 (36%)	24 (48%)		
Age		Mean± SD (With CI 95%)	56.9 ± 7.90	53.84± 9.62	-	0.082
Smoking status		Yes	31 (62%)	23 (46%)	2.576	**0.108**
		No	19 (38%)	27 (54%)		
Vitamin D levels among cases and control		10 to 19.99	15 (30%)	1 (2%)	14.899	**0.001**
		20 to 29.99	5 (10%)	5 (10%)		
		>30	30 (60%)	44 (88%)		
Vitamin D levels among Grading of COPD	I & II (N=17)	10 to 19.99	0(0%)	-	**No statistical test was applied-due to 0 subjects in the cell**	
		20 to 29.99	2 (12.5%)			
		>30	15 (87.5%)			
	III & IV (N=33)	10 to 19.99	15(45.45%)			
		20 to 29.99	3 (9.09%)			
		>30	15 (45.45)			
Vitamin D levels in relation to No. of exacerbations	Up to 5 exacerbations (N=35)	10 to 19.99	4 (11.42%)	-	19.36	0.001
		20 to 29.99	4 (11.42%)			
		>30	27 (77.14%)			
	>5 exacerbations(N=15)	10 to 19.99	11 (73.33%)			
		20 to 29.99	1 (6.66%)			
		>30	3 (20%)			
Mean and standard deviation of Vitamin D among Stable COPD patients & COPD Exacerbation patients		Stable COPD	37.78 ±9.74	-	-	
		COPD Exacerbation	16.35 ± 2.10	-	-	

Descriptive analysis of no of exacerbations among the COPD cases	
1 to 2 / year	7 (14%)
3 to 5 / year	28 (56%)
>5 year	15 (30%)
Mean and standard deviation of vitamin D level among cases in comparison with Exacerbation of COPD	
1-2 Exacerbations /yr	39.36 ± 6.41
3-5 Exacerbations /yr	36.40± 12.24
>5 Exacerbations /yr	21.05± 7.89
Grading of COPD Patients	
I	5 (10%)
II	20 (40%)
III	18 (36%)
IV	7 (14%)

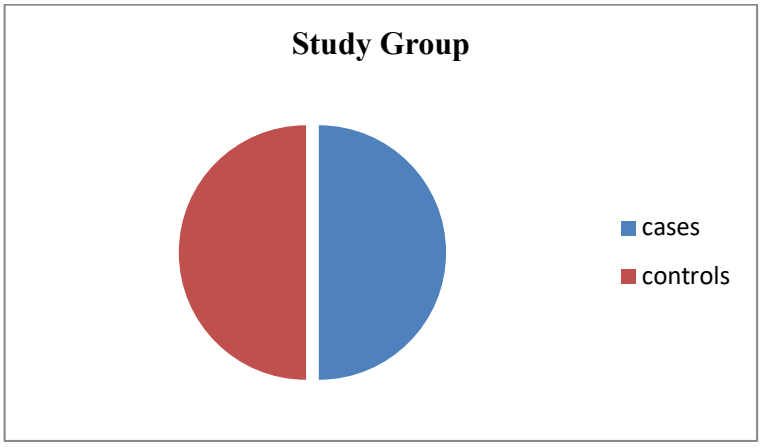

Figure 1: Pie chart of study group in the study population (N = 100)

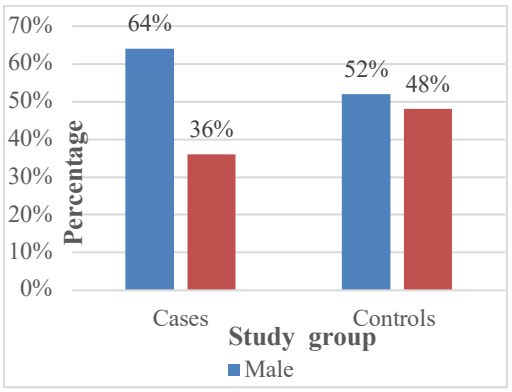

Figure 2: Clustered bar chart of Comparison of gender between study group (N=100)

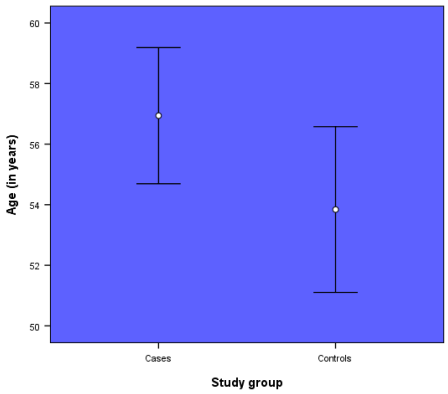

Figure 3: Comparative error bar chart of Comparison of mean of age between the study groups (N=100)

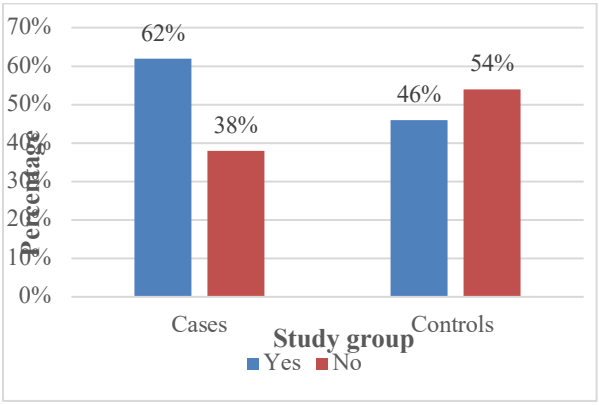

Figure 4: Clustered bar chart of comparison of smoker between study group (N=100)

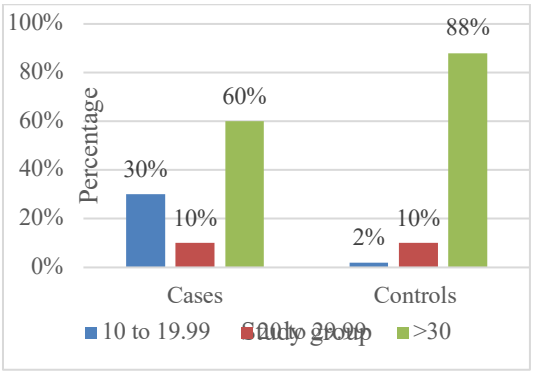

Figure 5: Clustered bar chart - Comparison of Grade of vitamin D level between study group (N=100)

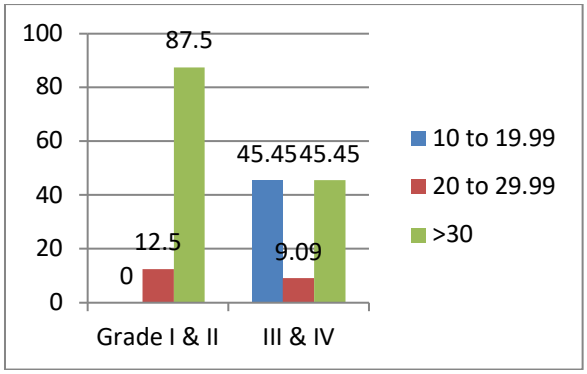

Figure 6: Bar chart of grading of COPD with vitamin d levels among the COPD cases (N=50)

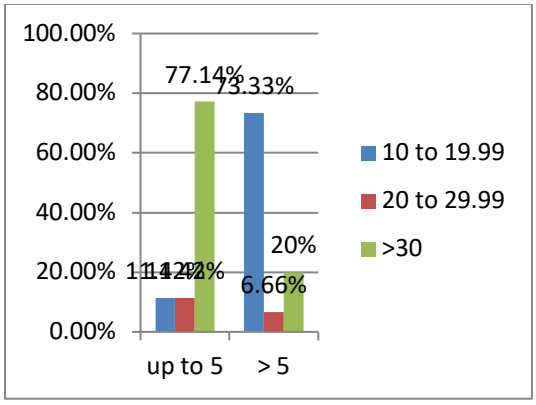

Figure 7: Bar chart of no of exacerbations with vitamin d level among the COPD cases (N=50)

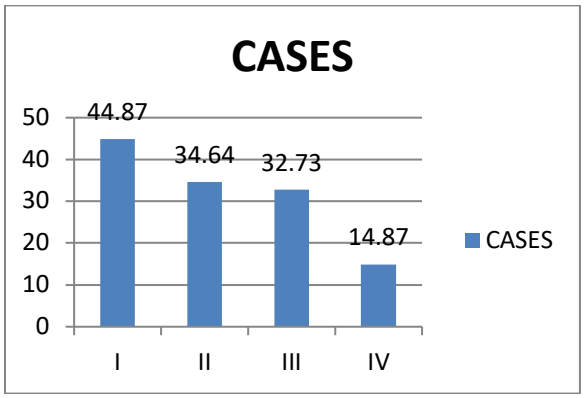

Figure 8: Mean and standard deviation of vitamin D level among cases in comparison with grading of COPD

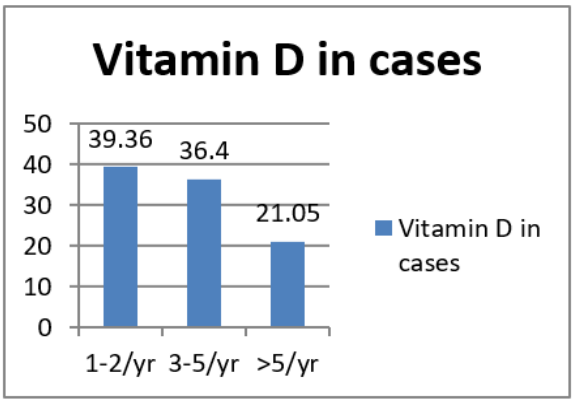

Figure 9: Bar chart of Mean and standard deviation of vitamin D level among cases in comparison with Exacerbation of COPD.

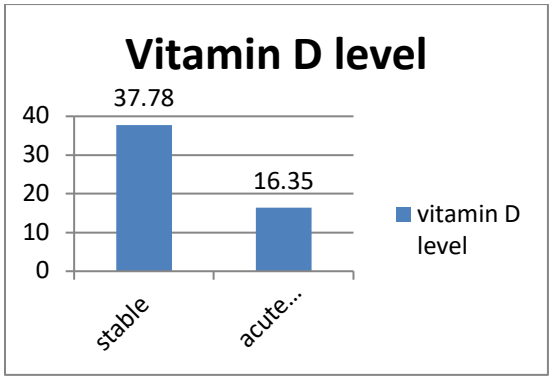

Figure 10: Bar graph showing Mean and standard deviation of vitamin D levels in stable patients and patients with acute exacerbations.

Discussion

With reference to age: [13],[17],[18]

In our study population the mean age of COPD cases and controls are 56.9 ± 7.90 and 53.84 ± 9.62. Persson LJP et al [13] in their study stated the mean age of COPD cases and controls as 63.5±6.9 and 58.6±9.8 respectively. In another study by Zhang et al [17] stated the mean age of COPD cases is 64.8±8.5.

In a study Dhadke et al [18] mentioned the mean age as 62. In comparison with the age differences of the above three studies, the age group in our study population is less. The reason for this could be due to the exclusion criterias in COPD cases. The other reason might be the difference in spirometric analysis in COPD patients.

With reference to Gender: [12],[13]

In our study the percentage of male participants are 64% and female participants are 36%, which suggest that incidence among males is almost double. Study done by Janssens W et al [12] found that 82.06% of COPD cases were males and 17.94% were females with vitamin D deficiency.

Similar study by Persson LJP et al [13] found that 60% of COPD cases were males and 40% of COPD cases were females. In the study done by Janssens W et al[12] there was a high proportion of COPD among males (82.06%), which could have been due to the selection of COPD patients with smoking history of atleast 15 pack years.

When comparing the present study with other two studies shows high prevalence of Vitamin D deficiency in male COPD patients.

The incidence among Smokers: [12],[19]

In our study the incidence is 62% among smokers with COPD. Previous studies done by Janssens W et al[12] and Thakuria R et al[19] have shown a strong correlation between vitamin D deficiency in smokers which is a strong factor for exacerbation of COPD.

Vitamin D levels & COPD: [12],[13],[20],[21],[22]

In our study the mean Vitamin D level among COPD is 32.21 ± 12.68 and Healthy volunteers is 52.05 ± 1.99 respectively. The result of the study correlates with various other studies like Monadi M et al [20], Persson LJP et al [13], Janssens W et al [12], which have shown a low vitamin D level among COPD patients. Vitamin D deficiency is significantly more common in COPD patients (64.5%) than controls.[21] The mean vitamin D of subjects in cases was 32.21 ± 12.68 and it was 52.05 ± 1.99 in controls. The difference in vitamin D between the two groups was statistically significant (P Value<0.001).[22] In all the studies, the vitamin D levels among controls were normal.

Grading of Vitamin D levels: [13]

In our study 30% of the patients had vitamin D levels between 10-19.99ng/dL, 10% had levels 20 to 29.99ng/dL, 60% with >30ng/dL. 88 % of controls had vitamin D levels > 30 ng/dL. Study done by Persson LJP et al [13] had shown 33 % had vitamin D levels of 10-19.99 ng/dL, 67% had 20 to 29.99ng/dL among cases and in controls 34% had vitamin D level of 10-19.99ng/dL and 66% had 20 to 29.99ng/dL. Suggesting that there is reduced levels of vitamin D among COPD patients.

Comparison of severity of COPD & vitamin D levels: [13]

In our study vitamin D levels have shown marked reduction with severity of COPD. Vitamin D levels in Grade III & Grade IV have shown severe reduction. Study done by Persson LJP et al [13] also has shown reduction of vitamin D level in Grade III & Grade IV severity of COPD.

Vitamin D level & Exacerbation of COPD [13]

In our study the level of Vitamin D levels among COPD patients with less than 2 episodes of exacerbations per year is 39.26±6.41 and level of Vitamin D levels among COPD patients with more than ≥2 exacerbations per year is 31.04±13. An

another study done by Persson LJP et al[13] found that the level of vitamin D among cases with exacerbations < 2 episodes per year was 25.4±9.9 and exacerbations ≥ 2 episodes per year was 23.7±10.5. The COPD patients with exacerbations ≥ 2 episodes per year showed marked reduction in vitamin D levels.

Conclusion

The study concludes that there is an increase in the incidence of COPD among males (64%).The mean age of the COPD cases and Controls are 56.9 ± 7.90 and 53.84 ± 9.62.Vitamin D deficiency is present in 40% of COPD patients and 12% of controls. The mean Vitamin D level among COPD patients and Healthy volunteers in the present study are 32.21 ± 12.68 and 52.05 ± 1.99 respectively. In the present study the mean Vitamin D levels among COPD patients with less than 2 exacerbations/year and more than ≥2 exacerbations/year are 39.26±6.41 and 31.04±13.11 respectively. Vitamin D levels correlate inversely with the increase in severity of COPD. The above findings suggest that there is Vitamin D deficiency in all COPD patients. Further studies involving large study groups is needed for adding Vitamin D as an adjuvant therapy in patients with COPD to find out therapeutic & treatment output.

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References

1. Global Initiative for Chronic Obstructive Lung Disease 2020 Report. Global Strategy for the Diagnosis, Management and Prevention of COPD 2023. https://goldcopd.org/gold-reports/
2. World Health Organization. Chronic obstru ctive pulmonary disease (COPD). [Online]; 2024 [cited 2024 12 1. Available from: www.who.int/respiratory/copd/en/.
3. Agusti A, Melen E, DeMeo DL, Breyer-Kohansal R, Faner R. Pathogenesis of chronic obstructive pulmonary disease: understanding the contributions of gene- envirnoment interactions across the lifespan. Lancet Respir Med 2022;10(5):512-524
4. Sin DD, Doiron D, Agusti A, et al. Air pollution and COPD: GOLD 2023 committee report. Eur Respir J 2023;61(5)
5. Yang IA, Jenkins CR, Salvi SS. Chronic obstructive pulmonary disease in never-smokers:risk factors, pathogenesis, and implications for prevention and treatment. Lancet Respir Med 2022;10(5):497-511
6. Fan H, Wu F, Liu J, et al. Pulmonary tuberculosis as a risk factor for chronic obstructive pulmonary disease: a systematic review and meta-analysis. Ann Transl Med 2021;9(5):390
7. Young AR, Morgan KA, Harrison GI, et al. A revised action spectrum for vitamin D synthesis by suberythemal UV radiation exposure in humans in vivo. Proc Natl Acad Sci U S A. 2021; 118(40). doi:10.1073/pnas.2015867118
8. Lange NE, Sparrow D, Vokonas P, Litonjua AA. Vitamin D deficiency, smoking, and lung function in the Normative Aging Study. Am J Respir Crit Care Med. 2012; 186(7):616–621. doi:10.1164/rccm.201110-1868OC
9. Bocheva G, Slominski RM, Slominski AT. The Impact of Vitamin D on Skin Aging. Int J mol Sci. 2021; 22(16). doi:10.3390/ijms22169097
10. Kiani AK, Dhuli K, Donato K, et al. Main nutritional deficiencies. J Prev Med Hyg. 2022; 63(2 Suppl 3):E93–E101. doi:10.15167/2421-4248/jpmh2022.63.2S3.2752
11. Forli L, Halse J, Haug E, et al. Vitamin D deficiency, bone mineral density and weight in patients with advanced pulmonary disease; J Intern Med. 2004;256(1):56-62
12. Janssens W, Bouillon R, Claes B, et al. Vitamin D deficiency is highly prevalent in COPD and correlates with variants in the vitamin D-binding gene; Thorax. 2010 Mar;65(3):215-220
13. Persson LJ, Aanerud M, Hiemstra PS, et al. Chronic obstructive pulmonary disease is associated with low levels of vitamin D; PLoS ONE. 2012; 7(6):e38934.
14. Lakra A, Singh B, Janmeja AK, Sharma V, Kumar A. A study to assess the relationship between vitamin D3 levels and the risk of acute exacerbation in patients with chronic obstructive pulmonary disease. Monaldi Arch Chest Dis. 2025 Mar 31; 95(1). doi: 10.4081/monaldi.2024.2885.
15. Li B, Liu M, Wang Y, Zhang H, Xuan L, Huang K, An Z. Association of severe vitamin D deficiency with hospitalization in the previous year in hospitalized exacerbated COPD patients. Int J Chron Obstruct Pulmon Dis. 2024 Jun 25; 19:1471–8. doi:10.2147/COPD.S461029.
16. Jolliffe DA, Greenberg L, Hooper RL, Mathyssen C, Rafiq R, de Jongh RT, et al. Vitamin D to prevent exacerbations of COPD: Systematic review and meta-analysis of individual participant data from randomised controlled trials. Thorax 2019; 74:337-45.
17. Zhang J, Lin XF, Bai CX. Comparison of clinical features between non-smokers with COPD and smokers with COPD: a

retrospective observational study. Int J Chron Obstruct Pulmon Dis. 2014; 9: p. 57-63
18. Dhadke VN, Dhadke SV, Raut N. Clinical profile in chronic obstructive pulmonary disease patients and their evaluation with spirometry and 2D ECHO. International Journal of Current Research. 2015 Feb; 7(2): p. 12480-12488.
19. Thakuria R, Maitra T, Deka J. Vitamin D Deficiency: A Factor For Exacerbation of COPD: Myth or Fact.
20. Monadi M, Heidari B et al. Relationship between serum vitamin D and forced expiratory volume in patients with chronic obstructive pulmonary disease (COPD). Caspian J Intern Med 2012; 3(3): 451-455.
21. Lokesh KS, Chaya SK, Jayaraj BS, Praveena AS, Krishna M, Madhivanan P, Mahesh PA. Vitamin D deficiency is associated with chronic obstructive pulmonary disease and exacerbation of COPD. Clin Respir J. 2021 Apr; 15(4):389–99. doi:10.1111/crj.13310.
22. Patel KA, Patel PH, Vaid MP, Dandge V. A case-control study of vitamin D levels in chronic obstructive pulmonary disease patients and healthy volunteers in South Gujarat, India. Natl J Med Res. 2022; 12(4):73–76. doi: 10.554 89/njmr.12042022931.