

Vitamin D: A Silent Cofactor for Allergic Rhinitis

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ABSTRACT

Introduction:

Allergic rhinitis affects around 50% of atopies in India. Vitamin D is related to both humoral and cell mediated immunity and its receptors are found in inflammatory mediators. This study was conducted to assess any possible association between Allergic rhinitis and serum Vitamin D.

Materials and Methods

A cross sectional study was conducted amongst 41 patients with Allergic rhinitis as per ARIA guidelines attending the Otolaryngology outpatient Department of a peripheral tertiary care hospital. Vitamin D levels were assessed in patients with allergic rhinitis in terms of serum Ig-E level and absolute blood eosinophil count (ABEC).

Results

Among 41 patients, 31 patients (75.6%) had deficiency of vitamin D with mean Vitamin D level of 14.87 ± 1.56 ng/ml (normal vitamin D level-30-100 ng/ml and low < 20 ng/ml), mean serum Ig-E level was 1040 ± 303.83 IU/ml (normal-1.90-170 IU/ml by CLIA method) and mean ABEC 1226.77 ± 397.89 (normal-30-350/ml).

Conclusion

Low serum Vitamin D is common in Allergic rhinitis patients. Low serum Vitamin D seems to be a significant cofactor in aetiopathogenesis of Allergic rhinitis in most of the cases.

Keywords:

Rhinitis, Allergic; Vitamin D; Eosinophils

Allergic rhinitis is one of the commonest chronic conditions with a significant impact on the quality of life.¹ It has been found that the common symptomatology of allergic rhinitis are nasal congestion, sneezing, nasal itching and rhinorrhea which shows significant overlap with non-allergic rhinitis.² Allergic rhinitis may be seasonal or perennial. Diagnosis is done by history and detailed examination and can be confirmed by skin prick test or estimation of IgE by radio allegro-sorbent test (RAST), enzyme linked immune sorbent assay (ELISA) and blood Eosinophil count.

Vitamin D is a hormone with multiple physiological actions. Vitamin D receptor is expressed in many cell types like T cell, B cell, neutrophil, macrophage.³ This

suggests the role of Vitamin D on immune system.⁴ It has been demonstrated that Vitamin D affects innate and adaptive immune system. In innate immunity Vitamin D inhibits the expression of Toll like Receptor (TLR) on monocyte, inhibits pro-inflammatory cytokine production and induces antimicrobial peptide synthesis. The main source of Vitamin D is solar UV-B (290–315 nm wavelength) which influences the formation of pro-vitamin D in the skin (cholecalciferol). Cholecalciferol from the skin or that derived from nutrition is metabolized in liver to 25-(OH) Vitamin D. This is the major circulating form. Thus it is usually used to measure serum Vitamin D level. 25-(OH) Vitamin D is then transported to kidney where it is metabolized to its active form calcitriol.^{4,5,6}

Although threshold of serum 25-(OH) Vitamin D are still debated, guidelines from Institute Of Medicine (IOM) for bone health define “Vitamin D deficiency as serum 25-(OH) Vitamin D levels below 30 nmol/L (< 12 ng/ml)”, while sufficient Vitamin D levels should be considered serum level of at least 50 nmol/L (20 ng/

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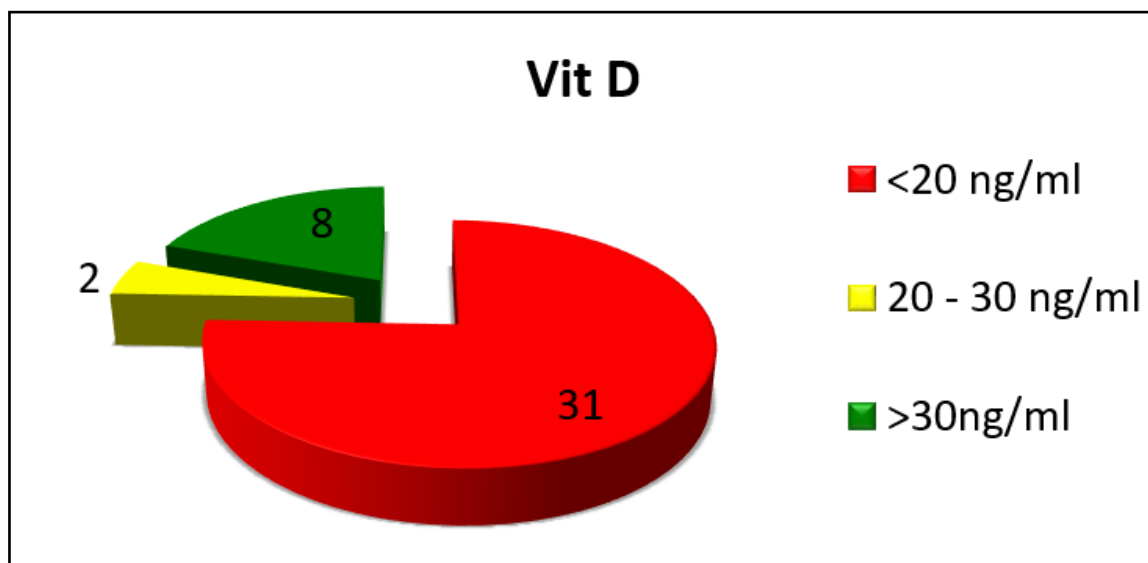


Fig. 1. Pie diagram showing distribution of Vitamin D levels amongst the study subjects

ml).⁵ Due to evidence of Vitamin D insufficiency on allergic disease prevalence, many researchers categorize Vitamin D deficiency as <75 nmol/L(30 ng/ml).³ This study was conducted to evaluate correlation between Vitamin D level and incidence of Allergic Rhinitis in a group of patients in terms of serum Ig-E level and absolute eosinophil count.

Materials and Methods

A cross-sectional study was conducted with randomized selection of patients suffering from allergic rhinitis attending the Otolaryngology out-patient department of a peripheral tertiary care institution from January 2016 to October 2017. A Total of 41 patients aged more

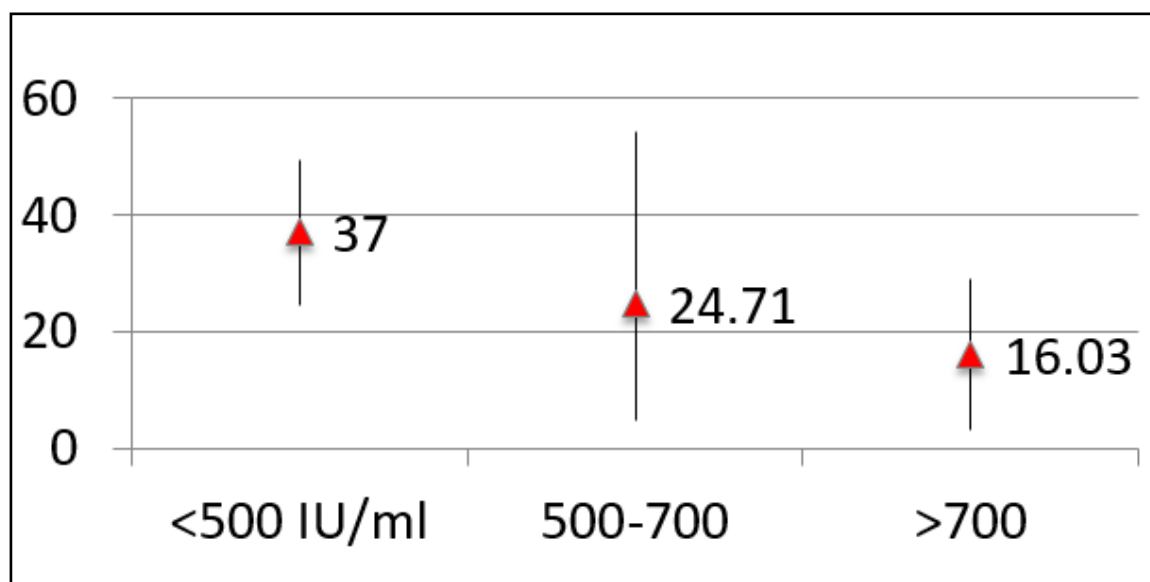


Fig. 2. Comparison between serum (max & min) Vitamin D (abscissa) & Serum IgE (ordinate)

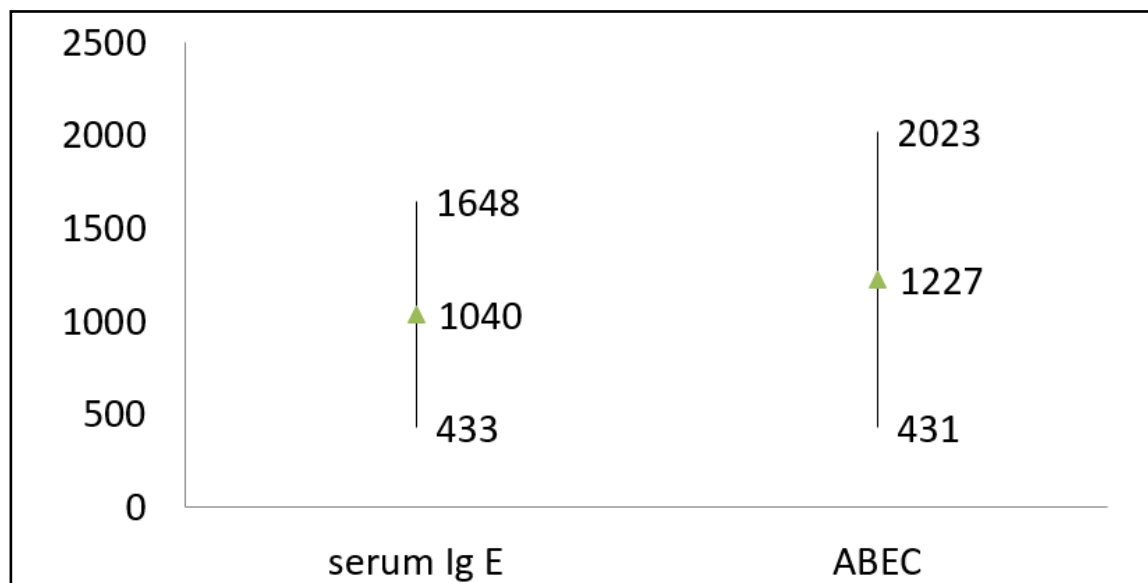


Fig. 3. Stock diagram of IgE level & ABEC in 31 patients (vitamin D<20ng/ml)

than 11 years were included as per symptoms and signs (ARIA Guideline).

Patients with co-morbid disease that could affect Serum level of Vitamin D e.g. Rheumatoid Arthritis, Cystic Fibrosis, Multiple Sclerosis, Ulcerative Colitis, Crohn's Disease, Celiac Disease, Rickets etc. were excluded from the study. The parameters assessed were Absolute Blood Eosinophil Count (ABEC), serum Ig-E level and serum 25(OH) Vitamin D.

Results

Out of total 41 patients included in our study, there were 25 males and 16 females with a male: female ratio of 61:39. Vitamin D deficiency (<20 mg/ml) was found in 75.6% of study population (31 patients). (Fig. 1)

Mean Vitamin D level in deficient cases was 14.87 ± 1.56 ng/ml and mean IgE level was 1040 ± 303.83 IU/ml which is elevated considering normal level of IgE up to 170 IU/ml. Mean ABEC was 1226.77 ± 397.89 /ml assuming normal Eosinophil count 350/ml.

P value was <0.0001 between IgE and Vitamin D. (Fig.2) P value was also <0.0001 in ABEC and Vitamin D. (Fig.3)

Discussion

This study sought to detect the incidence of vitamin D insufficiency (serum 25(OH) vitamin D calcidiol) among 41 patients of allergic rhinitis and to correlate the relation between vitamin D level, serum IgE and ABEC. The study showed that 75.6% of the patients had vitamin D deficiency. The mean value of 25(OH) vitamin D was significantly lower in allergic rhinitis patients.

In the present study, the mean level of Vitamin D is 14.87 ± 1.56 ng/ml. There are other studies in the available literature recently coming in support of this fact as stated by Arshi et al.⁸ The prevalence of severe Vitamin D deficiency was significantly higher in patients with Allergic rhinitis than normal population.⁹ According to Halonen et al.¹⁰ a significant relationship exists between serum IgE levels and eosinophilia presumed to be free of parasites where IgE levels presumably provide a better clue to atopy than do skin test. Kose et al. showed majority of Allergic rhinitis had Vitamin D deficiency and the mean level was 14.7 ng/ml.¹¹ Jung et al. found association between low Vitamin D level (mean 16.71 ng/ml) and Allergic rhinitis prevalence.¹² Modh et al. in his study also found correlation between serum Vitamin D (mean value 18.03 ± 5.61) and Allergic rhinitis.⁹

But in a large review by Ghaffari et al. it is found two

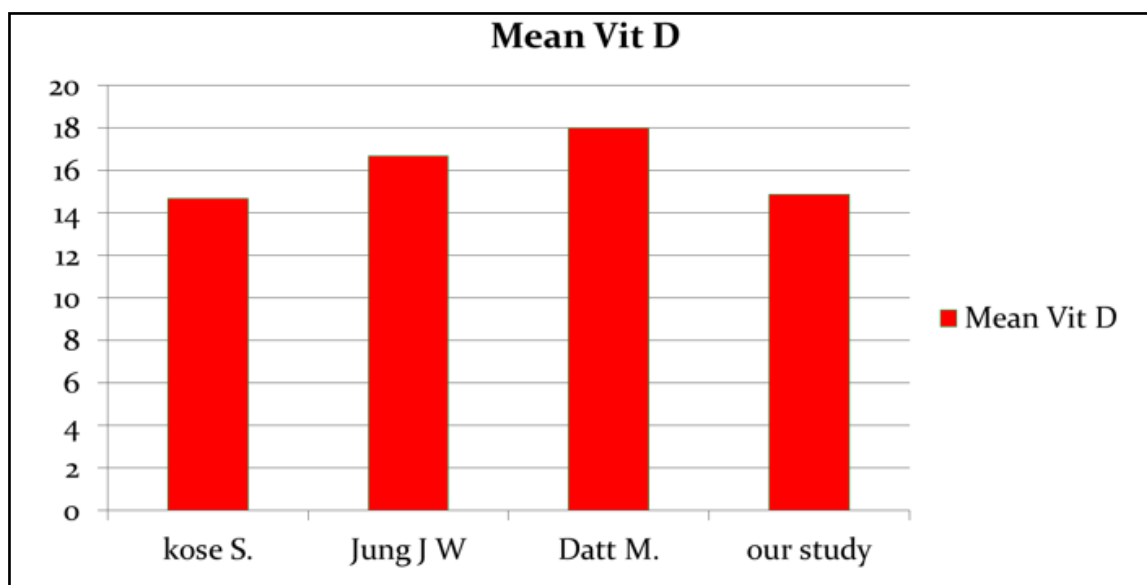


Fig. 4. Comparison of mean Vitamin D level in different studies

third of the reviewed studies show a correlation between serum level of vit D and Allergic rhinitis.¹³ Cheng et al. showed no correlation between Allergic rhinitis and vitamin D deficiency.¹⁴ (Fig. 4)

The improvement in the allergic status can be attributed to the immune-modulator effects of vitamin D on the immune system: Vitamin D regulates the activity of various immune cells, including monocytes, dendritic cells, T and B lymphocytes, as well as immune functions of epithelial cells.⁴ Furthermore, some immune cells express vitamin D activating enzymes facilitating local conversion of inactive vitamin D into active calcitriol with subsequent paracrine and autocrine effects.^{15,16} As 25(OH) vitamin D serum levels are low in individuals and vitamin D influences allergy mediating immune cells such as T-cells and immune functions of cells forming the barriers against allergies such as epithelial cells, one might speculate that vitamin D plays a role in allergy development. First scientist who hypothesized a link between nutritional intake of vitamin D and allergies were Wjst and Dold in 1999.¹⁷

Effect of vitamin D on innate immunity: Innate immune responses comprise all mechanisms that resist infection, but do not require specific recognition of the pathogen. Several aspects of innate immunity are affected by vitamin D. The expression of pattern recognition

receptor, which activates innate immune responses such as Toll-like receptors (TLRs) on monocytes are inhibited by Vitamin D, which leads to suppression of TLR-mediated inflammation.⁶ Vitamin D induces autophagy in human macrophages, which helps in the defense against opportunistic infections.¹⁸ The endogenous antimicrobial peptide in resident epithelial cells in the skin and lung are induced by Vitamin D, thereby strengthening the innate barriers against environmental allergens.^{19,20}

Effect of vitamin D on adaptive immunity: Lymphocytes such as T-cell with Th1 and Th2 polarization are major players in adaptive immunity and vitamin D modulates their functions. Pro-inflammatory cytokine release from peripheral mononuclear blood cells in general and from T-cells in particular are decreased by vitamin D.^{21,22} In addition, T-cell proliferation is suppressed by vitamin D through decreased Th1 cytokine production.²³ Vitamin D increases IL-10 and decreases IL-2 production, thereby promoting the state of hypo-responsiveness in T regulatory cells – an effect which is also seen with anti-allergic therapies such as corticosteroids or allergen immunotherapy.²³

Effect of vitamin D on IgE secretion, mast cells and eosinophils: Vitamin D also affects B lymphocytes functions and modulates the humoral immune response

including secretion of IgE.²⁴ Allergy-mediating cells such as mast cells and eosinophils are also targets of vitamin D. Increased cutaneous vitamin D synthesis increases IL-10 production in mast cells, which leads to suppression of skin inflammation.²⁵ Vitamin D treated mice showed reduced airway hyper-responsiveness and decreased infiltration of eosinophils in the lungs.²⁶

Conclusion

Measurement of serum vitamin D level could be helpful in routine assessment of patients with allergic rhinitis. Supplementation of Vitamin D might alter the natural course of disease, leading to significant clinical outcome and perhaps reduce the morbidity of the patient. Hopefully, Vitamin D supplementation may also reduce intranasal corticosteroid related side effects.

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