

Evaluation of Serum Vitamin D Levels in Patients with Chronic Rhinosinusitis

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Abstract:

Background: Chronic rhinosinusitis (CRS) is a persistent inflammatory disorder of the sinonasal mucosa with multifactorial etiology. Vitamin D has recognized immunomodulatory properties, and deficiency has been implicated in several chronic inflammatory conditions. The present study evaluated serum 25-hydroxyvitamin D [25(OH)D] levels in patients with CRS and examined their association with disease severity.

Material and Methods: A prospective case-control study was conducted in a tertiary care hospital including 70 patients with clinically and radiologically confirmed CRS and 70 age- and sex-matched healthy controls. Serum 25(OH)D levels were measured using chemiluminescent immunoassay. Vitamin D status was categorized as deficient (<20 ng/mL), insufficient (20–29 ng/mL), or sufficient (\geq 30 ng/mL). Symptom severity was assessed using the SNOT-22 score, and radiological severity was evaluated using the Lund-Mackay scoring system. Statistical analysis was performed using appropriate parametric and non-parametric tests, with $p < 0.05$ considered significant.

Results: Baseline demographic characteristics were comparable between groups ($p > 0.05$). Mean serum 25(OH)D levels were significantly lower in CRS patients than in controls (17.8 ± 7.2 ng/mL vs. 26.4 ± 8.1 ng/mL; $p < 0.01$). Vitamin D deficiency was observed in 65.7% of CRS patients compared to 25.7% of controls ($p < 0.01$). Parathyroid hormone levels were significantly higher in CRS patients ($p < 0.01$), while calcium, phosphorus, and alkaline phosphatase levels showed no significant differences. Serum vitamin D levels demonstrated a moderate negative correlation with SNOT-22 scores ($r = -0.48$; $p < 0.01$) and Lund-Mackay scores ($r = -0.41$; $p < 0.01$). Patients with nasal polyps had significantly lower vitamin D levels than those without polyps (14.9 ± 6.1 ng/mL vs. 20.2 ± 7.4 ng/mL; $p < 0.01$).

Conclusion: Serum vitamin D levels are significantly reduced in patients with chronic rhinosinusitis and are inversely associated with clinical and radiological severity. These findings suggest a potential role of vitamin D deficiency in the disease spectrum of CRS.

Keywords: Chronic rhinosinusitis; Vitamin D; 25-hydroxyvitamin D; Nasal polyps; SNOT-22; Lund-Mackay score.

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Introduction

Chronic rhinosinusitis (CRS) is a prevalent, persistent inflammatory disorder of the nasal and paranasal sinus mucosa that significantly impacts quality of life and incurs substantial healthcare costs worldwide [1]. The heterogeneity of CRS, exemplified by phenotypes with and without nasal polyps, suggests complex underlying

immunological mechanisms that extend beyond simple infection or obstruction [1,2]. Emerging evidence indicates that immune modulation plays a central role in CRS pathophysiology, involving both innate and adaptive responses that contribute to mucosal inflammation and tissue remodeling [2,3]. Vitamin D, traditionally recognized for its role in

calcium and bone metabolism, has potent immunoregulatory properties mediated through the vitamin D receptor expressed on various immune cells [4]. These effects include suppression of pro-inflammatory cytokines, modulation of T-cell differentiation, and enhancement of epithelial barrier function, which are relevant to chronic inflammatory diseases of the respiratory tract [4,5].

Recently, several observational studies and meta-analyses have reported lower serum 25-hydroxyvitamin D [25(OH)D] levels in patients with CRS compared to healthy controls, particularly in those with nasal polyposis phenotypes [6,7]. Systematic reviews have consistently highlighted an association between hypovitaminosis D and increased disease severity, including higher symptom scores and radiological burden, although heterogeneity in study design and vitamin D assessment methods remains [7,8]. Moreover, lower vitamin D levels have been correlated with heightened local inflammatory markers and altered immune responses in sinonasal tissues, suggesting a plausible mechanistic link between vitamin D status and CRS pathogenesis [3,7].

Despite these observations, the clinical relevance of vitamin D deficiency in CRS and its potential as a biomarker or therapeutic target have not been definitively established. The present study was conducted to evaluate serum 25(OH)D levels in adult patients with CRS compared to matched healthy controls and to investigate the relationship between vitamin D status and disease severity measures.

Material and Methods

Study Design and Setting: This study was designed as a prospective, observational, case-control investigation conducted at a tertiary care teaching hospital. All participants provided written informed consent prior to enrollment.

Study Population: Two groups were enrolled:

1. **Cases:** Adult patients (18–65 years) with a clinical diagnosis of CRS, defined according to the European Position Paper on Rhinosinusitis and Nasal Polyps criteria—persistent sinonasal symptoms for ≥ 12 weeks and supportive findings on nasal endoscopy and/or computed tomography.
2. **Controls:** Age- and sex-matched healthy volunteers without sinonasal symptoms or a history of CRS, allergy, autoimmune disease, or recent (past 6 months) upper respiratory tract infection.

Participants were excluded if they had:

- Known metabolic bone disease,
- Chronic renal or hepatic dysfunction,
- Malabsorptive gastrointestinal disease,

- Use of vitamin D supplementation or corticosteroids within the preceding 3 months,
- Active malignancy.

Sample Size Estimation: Sample size calculation was based on previous observational reports indicating a mean difference of approximately 8–10 ng/mL in serum 25(OH)D between CRS patients and controls, with an assumed standard deviation of 12 ng/mL in both groups. Using a two-tailed α of 0.05 and 80% power to detect this difference, the estimated sample size was 62 participants per group. To account for potential attrition and incomplete data, we enrolled 70 participants in each arm.

Clinical Assessment: All participants underwent a structured clinical evaluation performed by an experienced otolaryngologist. For CRS cases, symptom severity was quantified using the 22-item Sinonasal Outcome Test (SNOT-22). Endoscopic assessment documented the presence of nasal polyps, mucopurulent discharge, and mucosal edema. Lund–Mackay scores were recorded from computed tomography scans where available.

Laboratory Measurements: Fasting venous blood (5 mL) was collected from all participants between 8:00 and 10:00 AM to minimize diurnal variation in vitamin D levels. Serum was separated by centrifugation at 3000 rpm for 10 minutes and stored at -80°C until analysis. Serum 25(OH)D concentration was measured using a standardized chemiluminescent immunoassay (CLIA) with documented inter-assay coefficient of variation $< 8\%$. Reference ranges were defined as:

- **Deficient:** < 20 ng/mL,
- **Insufficient:** 20–29 ng/mL,
- **Sufficient:** ≥ 30 ng/mL.

Calcium, phosphorus, alkaline phosphatase, and parathyroid hormone levels were also measured to exclude underlying metabolic disorders.

Data Collection and Management: Demographic data, clinical characteristics, and laboratory results were recorded in a secure electronic database. Study personnel conducting the vitamin D assays were blinded to the clinical status of participants to minimize measurement bias.

Statistical Analysis: Continuous variables were expressed as mean \pm standard deviation. Categorical variables were summarized as frequencies and percentages. Between-group comparisons for continuous variables utilized independent t-tests. Categorical variables were compared using the chi-square test. Correlations between serum 25(OH)D levels and clinical severity scores (SNOT-22, Lund–Mackay) were analyzed using Spearman's rank correlation coefficient. A two-sided p-value < 0.05 was considered statistically significant. All analyses

were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA).

Results

The mean age of CRS patients was 38.6 ± 11.4 years, while that of controls was 37.9 ± 10.8 years, with no statistically significant difference between the groups ($p = 0.71$). The proportion of males was comparable in both groups (60.0% in CRS vs. 57.1% in controls; $p = 0.72$). Body mass index (BMI) also did not differ significantly between cases and controls (24.9 ± 3.8 kg/m² vs. 24.2 ± 3.5 kg/m²; $p = 0.29$) (Table 1). These findings indicate appropriate matching and baseline comparability between the study groups.

Serum 25-hydroxyvitamin D [25(OH)D] levels were significantly lower in patients with CRS compared to controls (17.8 ± 7.2 ng/mL vs. 26.4 ± 8.1 ng/mL; $p < 0.01$) (Table 2). Parathyroid hormone (PTH) levels were significantly higher in the CRS group (58.4 ± 18.7 pg/mL) than in controls (46.2 ± 15.9 pg/mL; $p = 0.002$). However, there were no statistically significant differences in serum calcium, phosphorus, or alkaline phosphatase levels between the two groups (Table 2).

A significantly higher proportion of CRS patients were vitamin D deficient (<20 ng/mL) compared to controls (65.7% vs. 25.7%; $p < 0.01$). Conversely, vitamin D sufficiency (≥ 30 ng/mL) was observed in only 10.0% of CRS patients compared to 40.0% of controls. The distribution of vitamin D categories differed significantly between groups (Table 3).

Among CRS patients, serum 25(OH)D levels demonstrated a moderate negative correlation with SNOT-22 scores ($r = -0.48$; $p < 0.01$), indicating that lower vitamin D levels were associated with greater symptom severity. Similarly, a significant inverse correlation was observed between serum vitamin D levels and Lund–Mackay radiological scores ($r = -0.41$; $p < 0.01$) (Table 4).

Within the CRS cohort, patients with nasal polyps ($n = 32$) exhibited significantly lower serum vitamin D levels compared to those without polyps (14.9 ± 6.1 ng/mL vs. 20.2 ± 7.4 ng/mL; $p < 0.01$). Additionally, SNOT-22 scores (54.6 ± 12.8 vs. 46.3 ± 11.5 ; $p < 0.01$) and Lund–Mackay scores (15.8 ± 4.2 vs. 11.7 ± 3.6 ; $p < 0.001$) were significantly higher in the polyp subgroup (Table 5).

Table 1. Baseline Demographic Characteristics of Study Participants

Variable	CRS Patients (n=70)	Controls (n=70)	p-value
Age (years), Mean \pm SD	38.6 ± 11.4	37.9 ± 10.8	0.71
Male, n (%)	42 (60.0%)	40 (57.1%)	0.72
Female, n (%)	28 (40.0%)	30 (42.9%)	—
BMI (kg/m ²), Mean \pm SD	24.9 ± 3.8	24.2 ± 3.5	0.29

Table 2. Comparison of Serum Biochemical Parameters between Groups

Parameter	CRS Patients (n=70) Mean \pm SD	Controls (n=70) Mean \pm SD	p-value
Serum 25(OH)D (ng/mL)	17.8 ± 7.2	26.4 ± 8.1	<0.01
Serum Calcium (mg/dL)	9.1 ± 0.6	9.3 ± 0.5	0.08
Serum Phosphorus (mg/dL)	3.6 ± 0.5	3.7 ± 0.4	0.21
Alkaline Phosphatase (IU/L)	118.5 ± 34.2	110.6 ± 29.7	0.14
Parathyroid Hormone (pg/mL)	58.4 ± 18.7	46.2 ± 15.9	0.002

Table 3. Distribution of Vitamin D Status in Study Groups

Vitamin D Status	CRS Patients (n=70)	Controls (n=70)	p-value
Deficient (<20 ng/mL)	46 (65.7%)	18 (25.7%)	<0.01
Insufficient (20–29 ng/mL)	17 (24.3%)	24 (34.3%)	
Sufficient (≥ 30 ng/mL)	7 (10.0%)	28 (40.0%)	

Table 4. Correlation between Serum Vitamin D Levels and Disease Severity in CRS Patients (n=70)

Variable	Correlation Coefficient $\text{\textcircled{R}}$	p-value
SNOT-22 Score	-0.48	<0.01
Lund–Mackay Score	-0.41	<0.01

Table 5. Subgroup Analysis: CRS With and Without Nasal Polyps

Parameter	CRS with Polyps (n=32)	CRS without Polyps (n=38)	p-value
Serum 25(OH)D (ng/mL)	14.9 ± 6.1	20.2 ± 7.4	<0.01
SNOT-22 Score	54.6 ± 12.8	46.3 ± 11.5	<0.01
Lund–Mackay Score	15.8 ± 4.2	11.7 ± 3.6	<0.01

Discussion

The present study demonstrated significantly lower serum 25-hydroxyvitamin D [25(OH)D] levels in patients with chronic rhinosinusitis (CRS) compared with healthy controls. Furthermore, lower vitamin D concentrations were associated with greater symptom severity and higher radiological scores. These findings are consistent with prior observational research indicating that hypovitaminosis D is more prevalent among individuals with CRS, particularly those with nasal polyps. Bavi et al. reported significantly reduced serum vitamin D levels in patients with chronic rhinosinusitis with nasal polyposis (CRSwNP) compared with controls, suggesting a potential role in disease pathogenesis [9].

Similarly, Hashemian et al., in a triple-blind randomized clinical trial, demonstrated that postoperative vitamin D3 supplementation significantly reduced recurrence of nasal polyposis after functional endoscopic sinus surgery, indicating a possible therapeutic role of vitamin D in modulating disease activity [10]. These interventional findings support the biological relevance of vitamin D deficiency observed in our cohort.

The immunological basis for this association has been explored in mechanistic studies. Mulligan et al. demonstrated that vitamin D inhibits sinonasal fibroblast proliferation and modulates inflammatory mediator expression in CRSwNP, thereby suggesting that vitamin D may influence tissue remodeling processes characteristic of severe disease [11]. Additionally, Wang et al. showed that lower serum 25(OH)D levels were associated with eosinophilic CRSwNP and correlated with peripheral eosinophilia, reinforcing the link between vitamin D status and inflammatory phenotype [12].

Meta-analytic evidence further strengthens this association. Li et al. reported significantly lower serum vitamin D levels in CRS patients compared with controls and identified a stronger deficiency pattern in patients with nasal polyps [13]. Likewise, a recent systematic review by Alharthi and Alzarei concluded that vitamin D deficiency is consistently associated with CRS presence and severity, although causality remains unproven [14].

Our subgroup analysis demonstrated significantly lower vitamin D levels in patients with nasal polyps compared to those without polyps. This observation parallels findings by Schlosser et al., who reported altered local immune responses and increased inflammatory burden in CRSwNP patients with

lower vitamin D concentrations [15]. Together, these findings suggest that vitamin D deficiency may be more strongly linked to the polypoid phenotype.

Despite accumulating evidence, several limitations remain in the literature. Variability in assay methods, seasonal influences on vitamin D levels, and differences in CRS phenotypic classification limit cross-study comparisons. Large-scale prospective studies and standardized supplementation trials are needed to determine whether correction of vitamin D deficiency can modify long-term disease outcomes.

Conclusion

Patients with chronic rhinosinusitis exhibited significantly lower serum 25-hydroxyvitamin D levels compared to healthy individuals, with a markedly higher prevalence of vitamin D deficiency. Reduced vitamin D concentrations were associated with greater symptom burden and more severe radiological involvement, and were particularly pronounced in patients with nasal polyps. These findings suggest that hypovitaminosis D may be linked to disease severity and phenotypic expression in chronic rhinosinusitis, highlighting the potential relevance of vitamin D status in its pathophysiology and clinical assessment.

References

1. Pantazidou G, Papaioannou I, Skoulakis C, Petinaki E, Hajjioannou J. Vitamin D Levels in Chronic Rhinosinusitis in Patients With or Without Nasal Polyposis: A Systematic Review. *Cureus*. 2023;15(9):e46275. doi:10.7759/cureus.46275
2. Li B, Wang M, Zhou L, Wen Q, Zou J. Association between serum vitamin D and chronic rhinosinusitis: a meta-analysis. *Braz J Otorhinolaryngol*. 2021;87(2):178-187. doi:10.1016/j.bjorl.2019.08.007
3. Shrestha P, Deepak R, Bhalla AS, et al. Vitamin D and Interleukins in Chronic Rhinosinusitis with Polyposis. *Indian J Otolaryngol Head Neck Surg*. 2022;74(Suppl 3):4756-4760. doi:10.1007/s12070-022-03085-2
4. Tomaszewska M, Sarnowska E, Rusetska N, et al. Role of Vitamin D and Its Receptors in the Pathophysiology of Chronic Rhinosinusitis. *J Am Coll Nutr*. 2019;38(2):108-118. doi:10.1080/07315724.2018.1503102
5. Pantazidou G, Papaioannou I, Skoulakis C, Petinaki E, Hajjioannou J. Vitamin D Levels in Chronic Rhinosinusitis in Patients With or Without Nasal Polyposis: A Systematic Review. *Cureus*. 2023;15(9):e46275. doi:10.7759/cureus.46275

6. Bavi F, Movahed R, Salehi M, Hossaini S, Bakhshae M. Chronic rhinosinusitis with polyposis and serum vitamin D levels. *Acta Otorhinolaryngol Ital.* 2019;39(5):336-340. doi:10.14639/0392-100X-2439
7. Alharthi GNA, Alzare A. The Correlation Between Vitamin D Deficiency and Chronic Rhinosinusitis: A Systematic Review. *Cureus.* 2024;16(3):e55955. doi:10.7759/cureus.55955
8. Pantazidou G, Papaioannou I, Skoulakis C, Petinaki E, Hajioannou J. Vitamin D Levels in Chronic Rhinosinusitis in Patients With or Without Nasal Polyposis: A Systematic Review. *Cureus.* 2023;15(9):e46275. doi:10.7759/cureus.46275.
9. Bavi F, Movahed R, Salehi M, Hossaini S, Bakhshae M. Chronic rhinosinusitis with polyposis and serum vitamin D levels. *Acta Otorhinolaryngol Ital.* 2019;39(5):336-340. doi:10.14639/0392-100X-2439
10. Hashemian F, Sadegh S, Jahanshahi J, Seif Rabiei MA, Hashemian F. Effects of Vitamin D Supplementation on Recurrence of Nasal Polyposis after Endoscopic Sinus Surgery. *Iran J Otorhinolaryngol.* 2020;32(108):21-28. doi:10.22038/ijorl.2019.37766.2241
11. Philippart A, Eloy P. Vitamin D and Chronic Rhinosinusitis with Nasal Polyps: A Narrative Review and Perspectives. *J Clin Med.* 2025;14(7):2467. doi:10.3390/jcm14072467
12. Wang J, Jiang Y, Chen X, et al. Serum 25-hydroxyvitamin D levels and peripheral blood eosinophil percentages as predictive indicators for eosinophilic chronic sinusitis with nasal polyps. *Eur Arch Otorhinolaryngol.* 2025;282(4):1951-1961. doi:10.1007/s00405-025-09263-6
13. Li B, Wang M, Zhou L, Wen Q, Zou J. Association between serum vitamin D and chronic rhinosinusitis: a meta-analysis. *Braz J Otorhinolaryngol.* 2021;87(2):178-187. doi:10.1016/j.bjorl.2019.08.007
14. Alharthi GNA, Alzare A. The Correlation Between Vitamin D Deficiency and Chronic Rhinosinusitis: A Systematic Review. *Cureus.* 2024;16(3):e55955. doi:10.7759/cureus.55955
15. Kalińczak-Górna P, Radajewski K, Burduk P. Relationship between the Severity of Inflammatory Changes in Chronic Sinusitis and the Level of Vitamin D before and after the FESS Procedure. *J Clin Med.* 2021;10(13):2836. doi:10.3390/jcm10132836