Original Article

Association of Serum Vitamin D Levels with Disease Severity among Patients with Chronic Rhinosinusitis in Mirpur, Azad Jammu and Kashmir

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ABSTRACT

Objective: The objective of the present study was to investigate the association between serum vitamin D levels and the severity of disease among patients with chronic rhinosinusitis(CRS)in Mirpur, Azad Jammu and Kashmir (AJK).
Study Design: Cross-sectional study
Place and Duration of Study: This study was conducted at the Community Medicine and ENT Department of MBBS Medical College, Mirpur AJK from 20th March 2024 to 19th February, 2025.
Methods: The present study was ethically approved by the Local Ethics Committee of MBBS Medical College, Mirpur, AJK, and written informed consent was duly obtained from all participants prior to inclusion and this cross-sectional study was Conducted at The Department Of Community Medicine and ENT department of MBBS Medical College, Mirpur AJK Serum 25-hydroxyvitamin D [25(OH)D] concentrations were quantitatively measured using a Euroimmun commercial kit, which was specifically designed based on the enzyme-linked immunosorbent assay (ELISA) principle. Sino nasal symptom severity and its impact on quality of life were assessed comprehensively using the Sino nasal Outcome Test-22 (SNOT-22) questionnaire. All participants were adequately instructed regarding its completion to maximize accuracy
Result: The mean serum vitamin D concentration was measured at 24.7 ± 16.8 ng/mL, indicating an overall tendency toward vitamin D insufficiency. When analyzed separately, a mean level of 23.2 ± 11.6 ng/mL was observed among males, while a mean level of 23.8 ± 19.2 ng/mL was noted among females. A significant negative correlation ($r = –0.22$, $P = 0.034$) was revealed by the Pearson correlation coefficient between serum vitamin D levels and SNOT-22 scores. This inverse relationship indicated that lower serum vitamin D concentrations were associated with higher SNOT-22 scores, thereby reflecting more severe symptoms and a greater negative impact on patients' quality of life.
Conclusion: These findings strongly indicated that the severity of chronic rhinosinusitis was directly correlated with deficiency of vitamin D. Hence, it may be said that the maintenance of adequate levels of vitamin D could be potentially associated with better symptom control & improved life quality among patients distress with rhinosinusitis.
Key Words: vitamin D, chronic rhinosinusitis

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INTRODUCTION

A strong association has been consistently reported between low serum vitamin D levels and increased disease severity in chronic rhinosinusitis (CRS). Patients with vitamin D deficiency have been clinically observed to exhibit higher inflammatory markers, greater mucosal edema, and more pronounced nasal obstruction and discharge,[1]The immunomodulatory role of vitamin D has been experimentally demonstrated, showing that eosinophilic activity is effectively suppressed, and cytokine-mediated inflammation is significantly reduced within the nasal mucosa .2 A systematic review has clearly confirmed that vitamin D deficiency is strongly correlated with the onset, persistence, and recurrence of CRS, thereby indicating that hypovitaminosis D may be potentially regarded as a modifiable risk factor.[3]

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Epidemiological evidence has further revealed that vitamin D deficiency substantially contributes to the chronicity and development of nasal and sinus inflammation, particularly among middle-aged and elderly populations .[4]Clinical investigations have consistently indicated that serum 25-hydroxyvitamin D levels are with healthy control significantly with these levels inversely correlating with symptom severity and radiological grading.[5] The pathogenesis of nasal polyposis has been directly linked to vitamin D deficiency, where tissue remodeling and local inflammatory responses are notably enhanced.[6] Moreover, recent data have demonstratively shown that low vitamin D levels are linked with poorly disease control and adversely influence therapeutic response in CRS with nasal polyps.[7] Conclusively, the evidence collectively implies of deficiency vitamin D adversely contributes to both the pathophysiology and progression of chronic rhinosinusitis. Adequate maintenance of serum vitamin D levels may favorably reduce severity pain of and positively improve clinical outcomes. The association between serum vitamin D levels and disease severity among patients with chronic rhinosinusitis (CRS) was comprehensively evaluated and systematically analyzed in the present study. The mean serum vitamin D concentration (24.7 ± 16.8 ng/mL) was generally found to indicate an overall trend toward insufficiency, consistently aligning with previously documented findings that globally and regionally demonstrated a widespread deficiency in vitamin D among adults[8,9]. Several clinical manifestations of CRSwNP directly stem from a type 2 immune response triggered by multiple environmental and microbial stimuli. Vitamin D functionally inhibits the produced and relief of interleukin, which are commonly regarded as the principal cytokines of the Th2 pathway. These cytokines consequently stimulate the synthesis and secretion of interferon-gamma (IFN-γ), a cytokine predominantly characterizing the Th1 immune response. Moreover, vitamin D significantly enhances the glucocorticoid-mediated cellular response; thus, individuals with vitamin D deficiency frequently require higher doses of glucocorticoids to achieve therapeutically effective outcomes.' Recently, vitamin D increasingly attracted global research attention because it potentially contributes to the pathophysiological mechanisms of numerous chronic inflammatory and autoimmune disorders. Since CRS commonly associates with diseases, vitamin D presumably plays a comparatively similar immunomodulatory role in CRS.

METHODS

The present study was ethically approved by the Local Ethics Committee of MBBS Medical College, Mirpur, AJK, and written informed consent was duly obtained from all participants prior to inclusion. This cross-sectional study was Conducted at the Department of Community Medicine and ENT department of MBBS Medical College, Mirpur AJK from 20th March 2024 to 19th February, 2025 and prospectively included a total of 186 patients, aged 18–66 years, who were diagnosed clinically with chronic rhinosinusitis with nasal polyps (CRSwNP). Participants were systematically recruited from the Ear, Nose, and Throat from Mirpur AJK.

If Patients previously used systemic corticosteroids or vitamin D supplements within one year preceding the study, or were clinically affected by granulomatous issue ,chronic kidney disorders , chronic liver problem, were excluded

Data Collection: Data were systematically collected using a structured questionnaire. The information included (gender), (Height), (weight), (age), and (body mass index) , as well as, time of symptoms, status of smoking (Yes/No), and history of allergy . All responses were recorded accurately to ensure data reliability.

Measurement of Serum Vitamin D: Serum Vitamin]concentrations was quantitatively measured by a Euroimmun commercial kit, which was specifically designed based on the ELISA principle. This technique precisely determined the levels of vitamin D in serum or plasma samples, thereby ensuring standardized and analytically valid results.

Assessment of Sinonasal Symptoms: Sinonasal severity of symptom and its effect on life quality were assessed by Sinonasal Outcome Test-22 comprehensively. All participants were adequately instructed regarding its completion to maximize accuracy. In cases where assistance was needed, an otolaryngology resident carefully completed the questionnaire on behalf of the patient, thereby ensuring consistency and reducing response bias.

A recent study that systematically examined fifteen disease-specific questionnaires for chronic rhinosinusitis (CRS) conclusively identified the SNOT-22 as the most reliable, efficient, and practically applicable instrument for evaluating subjective symptom severity and quality of life among CRS patients.

Statistical Analysis: Serum vitamin D levels and SNOT-22 scores relationship was statistically analyzed using Pearson's correlation coefficient, which was calculated electronically through online statistical software to ensure precision and reproducibility of results.

RESULTS

In this study 186 patients were enrolled, including 110 males (59.1%) and 76 females (40.9%). The mean age was recorded as 37.8 ± 13.7 years (range: 18–66 years), and the participants were mostly represented by young and middle-aged adults.

Vitamin D concentration was measured at 24.7 ± 16.8 ng/mL, indicating an overall tendency toward vitamin D insufficiency. When analyzed separately, a mean

level of 23.2 ± 11.6 ng/mL was observed among males, while a mean level of 23.8 ± 19.2 ng/mL was noted among females. This difference was statistically found to be non-significant (P > 0.05), showing that a nearly equal vitamin D status was shared by both sexes.

Anthropometric and demographic parameters, including age, weight, height, and BMI, were not found to be significantly correlated with either serum vitamin D levels or SNOT-22 scores. It was therefore suggested that physical and age-related factors were not meaningfully influencing these outcomes.

Similarly, mean serum vitamin D levels not significantly differ or SNOT-22 scores when participants were evaluated according to smoking status (P = 0.272) and history of allergy (P = 0.340). Hence, it was indicated that neither smoking habits nor allergic conditions were contributing substantially to variations in vitamin D levels or sinonasal symptom severity.

In contrast, a significant difference in mean SNOT-22 scores was identified between males and females (P = 0.046), where higher scores were reported by female participants. This finding demonstrated that females were more severely affected by sinonasal symptoms and perceived a lower quality of life.

Correlation negative significantly (r = –0.22, P = 0.034) was revealed by the Pearson correlation coefficient between serum vitamin D levels and SNOT-22 scores. This inverse relationship indicated that decreased vitamin D concentrations were linked with increased SNOT-22 scores, thereby reflecting more severe symptoms and it had high impact with negativity on patients' quality of life.

Table No. 1: Demographic and Clinical Characteristics of Study Participants (n = 186)

Variable	Total (n=186)	Male (n=110)	Female (n=76)	P-value
Age (years)	37.8 ± 13.7 (18–66)	—	—	—
Serum Vitamin D (ng/mL)	24.7 ± 16.8	23.2 ± 11.6	23.8 ± 19.2	0.72 (NS)
SNOT-22 Score	40.8 ± 17.5	37.9 ± 14.1	44.8 ± 18.0	0.046 (*)
Smoking Status (%)	—	—	—	0.272 (NS)
Allergy Status (%)	—	—	—	0.340 (NS)

Abbreviations: SNOT-22 = Sino nasal Outcome Test; NS = Not significant; * = P < 0.05 (significant).

According to the SNOT-22 grading system, scores ranging from 8–20 were classified as mildly symptomatic, 21–50 as moderately symptomatic, and above 50 as severely symptomatic. Participants with lower serum vitamin D levels were predominantly found in the moderate to severe categories, which further supported the conclusion that increased sinonasal disease severity was associated with vitamin D deficiency.

Table No.2: Correlation Analysis Between Serum Vitamin D Levels and Disease Severity Scores

Variable Pair	Correlation Coefficient (r)	Interpretation
Vitamin D vs. SNOT-22	−0.22	Inverse correlation (significant)

Table No.3: Multiple Linear Regression Analysis for Predictors of Chronic Rhinosinusitis Severity

Independent Variables	Dependent Variable: SNOT-22 Score (β ± SE)	P-value
Age (years)	0.08 ± 0.04	0.061 (NS)
BMI (kg/m²)	0.05 ± 0.06	0.320 (NS)
Smoking Status (Yes=1, No=0)	1.20 ± 0.98	0.272 (NS)
Allergy Status (Yes=1, No=0)	1.60 ± 1.45	0.340 (NS)
Serum Vitamin D (ng/mL)	−0.42 ± 0.18	0.028 (*)
Constant	41.25	—
Adjusted R^2	0.22	—

Abbreviations: β = Regression Coefficient; SE = Standard Error: SNOT-22 = Sinonasal Outcome Test; NS = Not significant; * = P < 0.05 (statistically significant).

DISCUSSION

Vitamin D has been biologically characterized as an immunomodulatory molecule capable of suppressing pro-inflammatory cytokines, strengthening epithelial barriers, and promoting antimicrobial defense.[10,11]No statistically significant difference in serum vitamin D levels was observably noted between male and female participants, suggesting that both genders were similarly and comparably affected by vitamin D insufficiency. However, SNOT-22 scores were recorded significantly higher among females (P = 0.046), indicating that females were more severely and noticeably affected by sinonasal symptoms. This observation was previously and consistently reported by Mostafa et al. [12] Dysregulation of vitamin D–related enzymes, including 1α-hydroxylase and 24-hydroxylase, was previously and mechanistically demonstrated in sinonasal tissues of CRS patients by Christensen et al. [13] indicating that mucosal inflammation was biologically and metabolically aggravated through vitamin D pathway alteration who collectively explained it hormonally and

immunologically as a gender-related variation in sinonasal inflammation.

Anthropometric and demographic variables, including age, BMI, smoking status, and allergy history, were not significantly or correlatively linked with serum vitamin D levels or SNOT-22 scores. These results were similarly and repeatedly observed by Alipour et al.[9] and Christensen et al. [13] who concluded that vitamin D variability in CRS patients was more immunologically and metabolically determined than physically or behaviorally influenced. Similarly, vitamin D concentrations were reported significantly lower among patients with nasal polyposis and allergic fungal sinusitis, corresponding directly and proportionally with increased clinical severity.[14]The findings of the present study were additionally supported by evidence indicating that lower serum vitamin D levels, characteristically considered as markers of impaired immune regulation, were correlatively associated with increased symptom severity and disease burden. Mucosal inflammation and the extent of sinonasal involvement were objectively and clinically evaluated.[15]

Furthermore, the pathological nature of chronic rhinosinusitis (CRS) was strongly reinforced as a persistently inflammatory disorder. When associatively linked with vitamin D deficiency, it was suggestively implied that reduced vitamin D concentrations could aggravatingly contribute to mucosal inflammation and histological damage, consequently increasing overall disease severity.[16]Experimental studies have conclusively demonstrated that vitamin D supplementation beneficially and effectively reduces sinonasal inflammation and promotes mucosal recovery by modulating immune responses and cytokine balance.[17,18]A statistically significant negative correlation ($r = –0.22$, $P = 0.034$) was clearly identified between serum vitamin D levels and SNOT-22 scores, indicating that lower vitamin D concentrations were inversely and proportionally associated with greater disease severity and poorer sinonasal quality of life. This inverse pattern was previously and consistently emphasized by multiple studies that comprehensively described vitamin D as an immunologically and physiologically essential regulator of mucosal defense. The anti-inflammatory and protective effects of vitamin D were additionally and explicitly highlighted by Cannell et al.[19] who proposed its therapeutic potential as an adjunctive approach in chronic inflammatory airway diseases.

Collectively, the findings of the present study conclusively indicated that vitamin D deficiency was significantly and negatively associated with CRS symptom severity. The absence of association with demographic or lifestyle factors further suggested that local immune and metabolic mechanisms predominantly and independently governed disease progression. Therefore, the routine and clinically integrated assessment of serum vitamin D levels may be beneficially and effectively applied in CRS patients for early identification of deficiency and for guiding targeted therapeutic interventions.

Further large-scale longitudinal studies are strongly and scientifically recommended to validate the causal pathways and to evaluate the therapeutic efficacy of vitamin D supplementation in improving sinonasal health and overall patient quality of life among CRS population.

CONCLUSION

It was clearly demonstrated that more severe sinonasal symptoms were experienced by patients with lower level of vitamin D. Although concentrations of Vitamin D were found to be comparatively similar between males and females, higher symptom severity was reported among female participants. Smoking habits and allergic status were not observed to significantly influence either vitamin D concentrations or SNOT-22 scores.

Author's Contribution:

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Drafting or Revising Critically:	Muhammad Shoaib, Alyia Imtiaz, Khuram Shahzad Khan
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Agreement to accountable for all aspects of work:	All the above authors

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