

Correlation of Serum Vitamin D Levels with Clinical Parameters of Dry Eye Disease: A Hospital-Based Study.

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Abstract

Background and Objectives

Dry eye disease (DED) is a multifactorial disorder characterized by tear film instability, ocular surface inflammation and visual disturbance. Vitamin D possesses anti-inflammatory and immunomodulatory properties and may play a role in maintaining ocular surface health. The present study evaluated serum vitamin D levels in patients with DED and assessed their association with clinical parameters of disease severity.

Methods

This hospital based observational study was conducted over a period of one year from January 2022 to December 2023. Eighty-two patients aged >18 years with clinically diagnosed DED were enrolled. Dry eye evaluation included Ocular Surface Disease Index (OSDI), Tear Break-Up Time (TBUT), Schirmer's test, and fluorescein staining. Serum 25-hydroxy vitamin D levels were measured and categorized as deficient (<20 ng/mL), insufficient (20–30 ng/mL), or sufficient (>30 ng/mL). Correlations between vitamin D levels and dry eye parameters were analyzed statistically.

Results:

The mean age of participants was 42.8±11.6 years; 63.4 per cent were females. Mean serum vitamin D level was 18.4±6.1 ng/mL, with deficiency observed in 68.3 per cent of patients. Mean OSDI score was 36.5±11.2, mean TBUT was 7.2±2.4 seconds, and mean Schirmer's test value was 8.5±3.2 mm/5 min. Serum vitamin D levels showed a significant negative correlation with OSDI scores ($p<0.001$) and significant positive correlations with TBUT ($r=0.44$, $p<0.001$) and Schirmer's test values ($r=0.40$, $p<0.01$). Greater ocular surface staining was observed among vitamin D-deficient patients.

Interpretation & conclusions:

Vitamin D deficiency was highly prevalent among patients with DED and was significantly associated with greater symptom severity, reduced tear film stability, decreased tear secretion, and increased ocular surface damage. Assessment and correction of vitamin D deficiency may be beneficial as an adjunct in the comprehensive management of DED.

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Introduction

Dry eye disease (DED) is a common multifactorial disorder of the tears and ocular surface characterized by ocular discomfort, tear film instability, and visual disturbance [1]. It significantly affects quality of life and daily activities such as reading, driving, and prolonged screen exposure [2]. The disease is more common among females, elderly individuals, and patients with systemic or autoimmune disorders [3]. Inflammation of the ocular surface and lacrimal functional unit plays a major role in the pathogenesis of dry eye disease [4]. Vitamin D, a fat-soluble vitamin with immunomodulatory and anti-inflammatory properties, has recently gained attention for its role in ocular surface health [5]. Vitamin D receptors are present in corneal epithelium, conjunctiva, and lacrimal glands, suggesting its importance in tear film maintenance and epithelial integrity [6].

Vitamin D deficiency may contribute to dry eye disease by increasing ocular surface inflammation, reducing tear secretion, and destabilizing the tear film [7]. Several studies have demonstrated lower serum vitamin D levels in patients with dry eye disease and significant associations with tear break-up time, Schirmer's test, and symptom severity [8-11].

Therefore, the present hospital-based observational study was conducted to evaluate serum vitamin D levels in patients with dry eye disease and to determine its association with the severity of dry eye parameters.

Aim

To evaluate serum vitamin D levels in patients with dry eye disease

Original Article

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Keywords

Dry eye disease; ocular surface disease
index; Schirmer's test; tear break-up time;
vitamin D deficiency; vitamin D.

and to determine the association between vitamin D deficiency and the severity of dry eye parameters.

Methods

Study Design and Setting

This hospital-based observational study was conducted in the Department of Ophthalmology GMC Srinagar over a period of one year from January 2022 to December 2022.

Study Population

A total of 82 patients clinically diagnosed with dry eye disease attending the ophthalmology outpatient department were included in the study.

Participant selection

A total of 82 patients aged >18 years with clinically diagnosed dry eye disease were enrolled after obtaining written informed consent.

Inclusion Criteria

- Patients aged more than 18 years
- Patients diagnosed with dry eye disease based on symptoms and clinical examination
- Patients willing to participate and provide informed consent

Exclusion Criteria

- Patients with active ocular infection or ocular allergy
- History of ocular trauma or ocular surgery within the previous 6 months
- Contact lens users
- Patients with autoimmune disorders such as Sjögren Syndrome
- Patients using topical ocular medications other than lubricants
- Patients already receiving vitamin D supplementation
- Pregnant and lactating women

Detailed history and ophthalmic examination were performed in all patients.

Dry eye assessment was done using:

- Ocular Surface Disease Index (OSDI)
- Tear Break-Up Time (TBUT)
- Schirmer's test
- Fluorescein staining

Serum 25-hydroxy vitamin D levels were measured in all participants and categorized as deficient (<20 ng/mL), insufficient (20–30 ng/mL), and sufficient (>30 ng/mL).

Outcome variables

The primary outcome variable was serum 25-hydroxy vitamin D level. Secondary outcome variables included:

- Ocular Surface Disease Index (OSDI) score
- Tear Break-Up Time (TBUT)
- Schirmer's test value
- Fluorescein staining grade

Data collection and clinical assessment

A detailed history and comprehensive ophthalmic examination were performed in all participants. Dry eye evaluation included Ocular Surface Disease Index questionnaire, Tear Break-Up Time, Schirmer's test, and fluorescein staining. Serum 25-hydroxy vitamin D

levels were measured and categorized as deficient (<20 ng/mL), insufficient (20–30 ng/mL), and sufficient (>30 ng/mL).

Statistical analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences [SPSS] software. Continuous variables were expressed as mean $\pm$ standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test. Correlations between serum vitamin D levels and Ocular Surface Disease Index (OSDI) score, Tear Break-Up Time (TBUT), and Schirmer's test values were evaluated using Pearson's correlation coefficient. A p value <0.05 was considered statistically significant.

Results

A total of 82 patients diagnosed with dry eye disease attending the ophthalmology outpatient department were included in this hospital-based observational study. The demographic profile, serum vitamin D levels, and dry eye parameters were analyzed.

Demographic Characteristics

The age of the study participants ranged from 20 to 67 years, with a mean age of 42.8 ± 11.6 years. The majority of patients belonged to the 31–50 years age group.

Out of 82 patients:

- 52 (63.4%) were females
- 30 (36.6%) were males

Female predominance was observed among patients with moderate to severe dry eye symptoms.

Clinical Presentation

The most common presenting symptoms were:

- Foreign body sensation – 64 patients (78%)
- Burning sensation – 59 patients (72%)
- Ocular dryness – 56 patients (68.3%)
- Redness – 44 patients (53.7%)
- Excessive watering – 34 patients (41.5%)
- Blurring of vision – 30 patients (36.6%)

The mean duration of symptoms was 8.1 ± 3.4 months

The mean serum 25-hydroxy vitamin D level among study participants was 18.4 ± 6.1 ng/mL.

Vitamin D status among the patients was categorized as follows:

Vitamin D status	Serum level	Number of patients (n)	Percentage (%)
Deficient	<20 ng/ml	56	68.3%
Insufficient	20-30 ng/ml	18	22.0%
Sufficient	>30 ng/ml	8	9.7%

A high prevalence of vitamin D deficiency was observed among patients with dry eye disease.

Table 1. Serum vitamin D status and association with dry eye severity among study participants (n = 82)

Variable	Category	Number of patients (%)	Mean Vitamin D level (ng/mL)
Vitamin D Status	Deficient (<20 ng/mL)	56 (68.3)	—
	Insufficient (20-30 ng/ml)	18 (22.0)	
	Sufficient (>30ng/ml)	8 (9.7)	
Dry Eye Severity (OSDI)	Mild	20 (24.4)	25.1 ± 5.0
	Moderate	18.0 ± 4.6	18.0 ± 4.6
	Severe	12.7 ± 3.5	12.7 ± 3.5

A statistically significant negative correlation was found between vitamin D levels and OSDI score ($p < 0.001$).

Ocular Surface Disease Index (OSDI)

The mean OSDI score was 36.5 ± 11.2 .

Based on OSDI grading:

- Mild dry eye was seen in 20 patients (24.4%)
- Moderate dry eye in 38 patients (46.3%)
- Severe dry eye in 24 patients (29.3%)

Patients with lower serum vitamin D levels demonstrated higher OSDI scores, indicating greater symptom severity.

Tear Break-Up Time (TBUT) and Schirmer's Test

Table 2. Tear film and ocular surface parameters in patients with dry eye disease

Parameter	Category	Number of patients (n)	Percentage
TBUT (seconds)	<5	22	26.8
	5-10	48	58.5
	>10	12	14.7
Schirmer's test (mm/5 min)	<5	18	22.0
	5-10	46	56.1
	>10	18	22.0

The mean TBUT among study participants was 7.2 ± 2.4 seconds. Patients with severe vitamin D deficiency had significantly lower TBUT values compared to patients with sufficient vitamin D levels.

A positive correlation was observed between serum vitamin D levels and TBUT values ($r = 0.44$, $p < 0.001$). The mean Schirmer's test value was 8.5 ± 3.2 mm/5 min. Lower Schirmer's test values were associated with lower serum vitamin D levels.

A significant positive correlation was noted between serum vitamin D levels and Schirmer's test scores ($r =$

0.40 , $p < 0.01$).

Fluorescein Staining

Fluorescein staining revealed varying degrees of ocular surface involvement

Table 3. Fluorescein staining grades among patients with dry eye disease

Staining Grade	Number of Patients
Grade 0	10
Grade 1	24
Grade 2	34
Grade 3	14

Moderate to severe staining grades were more commonly observed in patients with vitamin D deficiency.

Discussion

Dry eye disease is increasingly recognized as a chronic inflammatory disorder of the ocular surface associated with tear film instability and ocular discomfort.¹ The present hospital-based observational study demonstrated a high prevalence of vitamin D deficiency among patients with dry eye disease and showed significant correlations between lower serum vitamin D levels and severity of dry eye parameters.

In the present study, female predominance was observed among dry eye patients. Similar findings have been reported in previous epidemiological studies where dry eye disease was more common among women, especially in middle-aged and postmenopausal females [3,12]. Hormonal influences affecting lacrimal gland

function and tear film stability may explain this increased prevalence in females [13].

The mean serum vitamin D level in the study population was low, with a large proportion of patients showing vitamin D deficiency. Similar observations have been reported by Kurtul et al., Yildirim et al., and Meng et al., who found significantly lower serum vitamin D levels in patients with dry eye disease [8,9,10]. Vitamin D deficiency has been associated with increased inflammatory cytokine activity and impaired immunomodulatory function, which may contribute to ocular surface inflammation [14].

The present study demonstrated a significant negative correlation between serum vitamin D levels and Ocular Surface Disease Index (OSDI) scores. Patients with lower vitamin D levels had more severe symptoms, indicating a possible role of vitamin D in maintaining ocular surface comfort and tear film stability. Similar findings were reported in previous studies evaluating symptom severity in vitamin D-deficient dry eye patients [10,11].

Tear film stability assessed by Tear Break-Up Time (TBUT) was significantly reduced in patients with lower serum vitamin D levels. Similar findings were observed by Kurtul et al., who reported significantly decreased TBUT values among vitamin D-deficient individuals [8]. Vitamin D is believed to improve epithelial barrier function and reduce ocular surface inflammation, thereby contributing to improved tear film stability [6,15].

Schirmer's test values were also lower in patients with vitamin D deficiency, suggesting reduced aqueous tear secretion. Similar results have been documented in previous studies assessing lacrimal gland function in vitamin D-deficient individuals [8,9]. Vitamin D receptors present in lacrimal gland tissue may influence tear secretion and ocular surface lubrication [6].

Fluorescein staining findings in the present study demonstrated greater ocular surface damage in patients with severe vitamin D deficiency. Increased staining indicates epithelial surface disruption secondary to chronic inflammation and tear film abnormalities. Comparable findings have been reported by Watters et al. and Demirci et al., who demonstrated increased ocular surface staining in vitamin D-deficient patients [11,16].

The anti-inflammatory and immunomodulatory properties of vitamin D may explain its beneficial role in ocular surface health. Vitamin D suppresses inflammatory cytokines, promotes epithelial healing, and enhances barrier function of the corneal epithelium [14,15]. Bae et al. demonstrated improvement in dry eye symptoms following vitamin D supplementation in patients refractory to conventional treatment, suggesting a potential therapeutic role of vitamin D supplementation in dry eye disease [17].

An additional finding of the present study was the association between reduced sunlight exposure and severity of dry eye disease. This observation may be particularly relevant in our region where lifestyle,

clothing practices, prolonged indoor activity among women especially those belonging to far peripheral areas, and climatic conditions predispose individuals to vitamin D deficiency despite adequate daylight availability. The finding highlights the importance of environmental and behavioral factors in the pathogenesis of dry eye disease.

The findings of the present study support the hypothesis that vitamin D deficiency may contribute to the pathogenesis and severity of dry eye disease. Evaluation of serum vitamin D levels in patients with persistent or severe dry eye symptoms may therefore be beneficial. Early correction of vitamin D deficiency may provide additional improvement when combined with standard dry eye treatment modalities.

However, the present study had certain limitations. It was a hospital-based observational study with a relatively limited sample size. Lack of follow-up after vitamin D supplementation limited assessment of therapeutic response. Further prospective and interventional studies with larger sample sizes are required to establish causality and evaluate the effectiveness of vitamin D supplementation in dry eye management.

Conclusion

The present hospital-based observational study demonstrated a high prevalence of vitamin D deficiency among patients with dry eye disease. Lower serum vitamin D levels were significantly associated with increased severity of dry eye symptoms, reduced tear film stability, decreased tear secretion, and greater ocular surface involvement.

These findings suggest that vitamin D deficiency may play an important role in the pathogenesis and severity of dry eye disease. Assessment of serum vitamin D levels in patients with chronic or severe dry eye may aid in comprehensive management and may provide additional benefit when corrected alongside conventional dry eye treatment.

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