Section: Miscellaneous

Original Research Article

ASSOCIATION BETWEEN SERUM VITAMIN D3 LEVELS AND SEVERITY OF ACNE VULGARIS IN ADOLESCENTS: A CROSS-SECTIONAL STUDY FROM NORTH INDIA

Mohammad Hamza Ansari[1], Usha Chandra[2], Kuldeep Kumar Gupta[3]

[1]*Assistant Professor, Department of Dermatology & Venereology, Uma Nath Singh Autonomous State Medical College, Jaunpur, Uttar Pradesh, India.*
[2]*Assistant Professor, Department of Dermatology & Venereology, Autonomous State Medical College, Shahjahanpur, Uttar Pradesh, India.*
[3]*Assistant Professor, Department of Biochemistry, Uma Nath Singh Autonomous State Medical College, Jaunpur, Uttar Pradesh, India.*

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Corresponding Author:
Dr. Kuldeep Kumar Gupta,
Assistant Professor, Department of Biochemistry, Uma Nath Singh Autonomous State Medical College, Jaunpur, Uttar Pradesh, India.
Email: kuldeepsnmc05@gmail.com

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ABSTRACT

Background: Acne vulgaris is a common inflammatory skin disorder of adolescence, influenced by hormonal, genetic, microbial, and environmental factors. Vitamin D3, known for its immunomodulatory and anti-inflammatory properties, has been implicated in skin health. However, its association with acne severity in Indian adolescents remains underexplored. This study aimed to assess the relationship between serum vitamin D3 levels and the severity of acne vulgaris in adolescents attending a tertiary care hospital in North India.

Materials and Methods: A prospective cross-sectional study was conducted in the Department of Dermatology in collaboration with the Department of Biochemistry at a tertiary care teaching hospital in North India from March 2024 to April 2025. A total of 139 adolescents aged 10–19 years with clinically diagnosed acne vulgaris were enrolled. Acne severity was graded using the Global Acne Grading System (GAGS). Serum vitamin D3 (25-hydroxyvitamin D) levels were estimated using a Chemiluminescence Immunoassay (CLIA) analyser. Data were analysed using SPSS version 21.0, with $p < 0.05$ considered statistically significant.

Results: Of the 139 participants, 72 (51.8%) were females and 67 (48.2%) were males, with the majority (66.9%) in the 15–19 years age group. Acne severity distribution was mild in 30.2%, moderate in 36.7%, and severe in 33.1% of cases. Mean serum vitamin D3 levels were significantly higher in males (23.5 ± 4.8 ng/mL) than in females (20.6 ± 4.5 ng/mL; $p = 0.004$). Vitamin D3 levels showed a significant decreasing trend with increasing acne severity—26.0 ± 2.1 ng/mL in mild, 24.5 ± 2.0 ng/mL in moderate, and 17.8 ± 1.7 ng/mL in severe acne ($p = 0.001$). A negative correlation was observed between serum vitamin D3 levels and GAGS scores in severe acne cases ($r = –0.047$, $p = 0.003$).

Conclusion: Lower serum vitamin D3 levels were significantly associated with increased severity of acne vulgaris in adolescents. These findings suggest that vitamin D status assessment and correction could be considered as an adjunctive strategy in acne management.

Keywords: Acne vulgaris, Vitamin D3, Adolescents, GAGS score, Acne severity, India.

INTRODUCTION

Acne vulgaris is one of the most common dermatological conditions, affecting approximately 85% of adolescents worldwide to varying degrees of severity.[1] It is a chronic inflammatory disorder of the pilosebaceous unit, characterised by both non-inflammatory lesions (comedones) and inflammatory lesions (papules, pustules, nodules) predominantly involving the face, chest, and back.[2] The condition

is not only of cosmetic concern but also has significant psychosocial implications, including reduced self-esteem, social withdrawal, and, in severe cases, depression.[3]

The pathogenesis of acne vulgaris is multifactorial, involving increased sebum production under androgenic stimulation, abnormal follicular keratinisation, colonisation by Cutibacterium acnes, and an inflammatory immune response.[4] Genetic predisposition and environmental factors such as diet, stress, and sunlight exposure further influence disease onset and severity.[5]

Vitamin D3 (cholecalciferol) is a secosteroid hormone essential for calcium homeostasis and bone metabolism. Beyond these classical roles, it has important immunomodulatory, anti-inflammatory, and antimicrobial properties, influencing both innate and adaptive immunity.[6] Vitamin D receptors are expressed in keratinocytes and sebocytes, and its active metabolite, calcitriol, regulates cell proliferation, differentiation, and cytokine production.[7] Experimental studies have demonstrated that vitamin D can suppress inflammatory mediators such as IL-6, IL-8, and TNF-α, which are implicated in acne pathogenesis.[8]

Recent studies from various regions have suggested an association between low serum vitamin D3 levels and increased severity of acne vulgaris.[9,10] Factors such as reduced sunlight exposure, increased indoor lifestyles, air pollution, and dietary deficiencies prevalent in urban India may contribute to widespread vitamin D insufficiency among adolescents.[11] However, there is limited literature from North India evaluating this association in a tertiary care hospital setting.

Given the potential role of vitamin D3 in modulating acne-related inflammation, and the high prevalence of vitamin D insufficiency in the Indian adolescent population, this study aims to evaluate the relationship between serum vitamin D3 levels and the severity of acne vulgaris in adolescents attending a tertiary care centre in North India.

MATERIALS AND METHODS

This prospective cross-sectional study was conducted in the Department of Dermatology in collaboration with the Department of Biochemistry at a tertiary care teaching hospital in North India from March 2024 to April 2025. Ethical clearance was obtained from the Institutional Ethics Committee, and written informed consent was taken from the parents or guardians of participants below 18 years of age. The study included adolescents aged 10 to 19 years, of either sex, clinically diagnosed with acne vulgaris attending the Dermatology OPD. Patients with history of systemic corticosteroid therapy, oral isotretinoin, vitamin D supplementation, or multivitamin use in the preceding six months, or vitamin D therapy for rickets, osteomalacia, or fractures, were excluded. The sample size was calculated to126, which was increased by 10% for non-response to give a final sample size of 139. All participants underwent detailed clinical evaluation including demographic profile, acne history, lifestyle factors, and BMI calculation. Acne severity was graded using the Global Acne Grading System (GAGS), categorising it as mild (1–18), moderate (19–30), severe (31–38), or very severe (>39). Under aseptic precautions, 2 mL of venous blood was collected, serum separated, and analysed within 24 hours for 25-hydroxyvitamin D using a Chemiluminescence Immunoassay (CLIA) analyser. Serum vitamin D3 levels were classified as deficient (0–10 ng/mL), insufficient (10–30 ng/mL), sufficient (30–100 ng/mL), or toxic (>100 ng/mL). Data were analysed using SPSS version 21.0, with quantitative data expressed as mean ± SD, qualitative data as frequency and percentage, comparisons between two groups made using the unpaired Student's t-test, multiple group comparisons by one-way ANOVA, and correlations assessed using Pearson's coefficient, with $p<0.05$ considered statistically significant.

RESULTS

Table 1: Demographic characteristics of study participants (n = 139)

Characteristic	Number (n)	Percentage (%)
Age group (years)		
10–14	46	33.1
15–19	93	66.9
Gender		
Male	67	48.2
Female	72	51.8
Place of residence		
Urban	56	40.3
Rural	83	59.7
BMI category		
Underweight (≤18.5)	9	6.5
Normal (18.5–24.9)	95	68.3
Overweight (25–29.9)	28	20.1
Obese (≥30)	7	5.0
Sun exposure		
>2 hours/day	95	68.3
<2 hours/day	44	31.7

Sunscreen use		
Yes	61	43.9
No	78	56.1
Family history of acne		
Present	78	56.1
Absent	61	43.9

In the present study of 139 participants, the majority (66.9%) were in the 15–19 years age group, while 33.1% were aged 10–14 years. Females constituted 51.8% of the study population, and males 48.2%. Most participants (59.7%) resided in rural areas, with 40.3% from urban settings. Based on BMI, 68.3% had a normal range, 20.1% were overweight, 6.5% underweight, and 5.0% obese. A majority (68.3%) reported sun exposure of more than two hours per day, while 31.7% had less than two hours' exposure. Sunscreen use was reported by 43.9% of participants, whereas 56.1% did not use sunscreen. A positive family history of acne was present in 56.1% of cases.

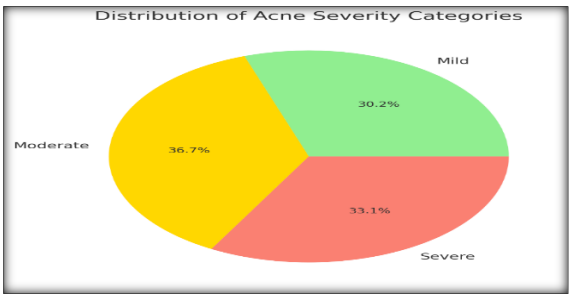

Figure 1: Distribution of Acne Severity Categories

Figure 2: Severity of Acne

Figure 1and 2 shows the distribution of acne severity among the 139 study participants. Mild acne was observed in 30.2% of cases, moderate acne in 36.7%, and severe acne in 33.1%. Moderate acne constituted the largest proportion, followed closely by severe acne, while mild acne accounted for the smallest share of cases. This pattern indicates that more than two-thirds of the participants presented with moderate to severe forms of acne.

Table 2: Mean serum vitamin D3 levels according to gender

Gender	Mean ± SD (ng/mL)	p-value
Male	23.5 ± 4.8	0.004*
Female	20.6 ± 4.5	

In the present study, the mean serum vitamin D3 level among males was 23.5 ± 4.8 ng/mL, which was higher than that of females (20.6 ± 4.5 ng/mL). This difference was statistically significant (p = 0.004), indicating that male participants had significantly higher serum vitamin D3 levels compared to female participants.

Table 3: Mean serum vitamin D3 levels according to acne severity

Severity	Mean ± SD (ng/mL)	p-value
Mild	26.1 ± 2.1	0.003*
Moderate	24.5 ± 2.0	
Severe	17.8 ± 1.7	

Table 3 shows that mean serum vitamin D3 levels decreased progressively with increasing acne severity. Adolescents with mild acne had the highest mean level (26.1 ± 2.1 ng/mL), followed by those with moderate acne (24.5 ± 2.0 ng/mL), while the lowest levels were observed in severe cases (17.8 ± 1.7 ng/mL). The difference across groups was statistically significant (p = 0.003), indicating an inverse relationship between serum vitamin D3 levels and acne severity.

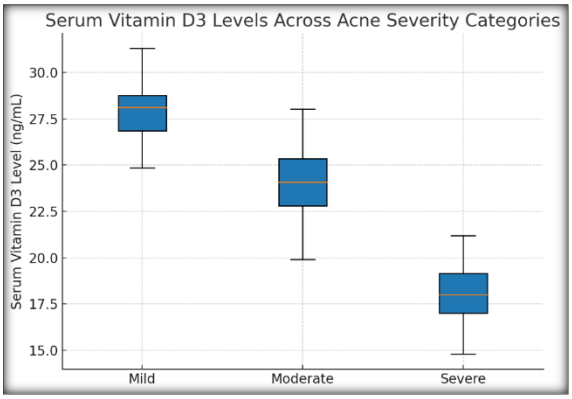

Figure 3: Serum Vitamin D3 Levels Across Acne Severity Categories

Figure 3 illustrates the distribution of serum vitamin D3 levels across different acne severity categories. The median and interquartile ranges show that participants with mild acne had the highest vitamin D3 levels, followed by those with moderate acne, while severe acne cases consistently exhibited the lowest levels. The trend demonstrates a progressive decline in vitamin D3 concentrations with increasing severity of acne, supporting a negative association between serum vitamin D3 levels and acne severity.

Table 4: Correlation between serum vitamin D3 levels and acne severity

Severity category	Mean vitamin D3 (ng/mL)	r-value	p-value
Mild	26.1	0.061	0.012*
Moderate	24.5	0.168	0.010*
Severe	17.8	–0.047	0.003*

Table 4 demonstrates a clear inverse relationship between serum vitamin D3 levels and acne severity. Mean vitamin D3 levels were highest in mild acne (26.1 ng/mL), declined in moderate cases (24.5 ng/mL), and were lowest in severe acne (17.8 ng/mL). Correlation analysis showed weak positive associations in mild (r = 0.061) and moderate acne (r = 0.168), while severe acne exhibited a negative correlation (r = –0.047). All associations were statistically significant ($p < 0.05$), supporting the link between lower vitamin D3 levels and greater acne severity.

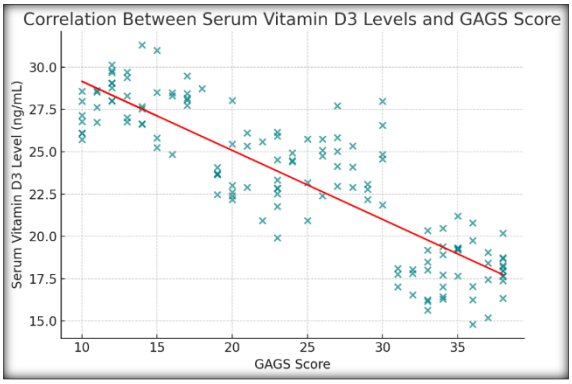

Figure 4: Correlation between Serum Vitamin D3 Levels and GAGS Score

Figure 4 depicts the correlation between serum vitamin D3 levels and Global Acne Grading System (GAGS) scores. A negative trend is evident, with serum vitamin D3 concentrations declining as GAGS scores increase. This inverse relationship suggests that participants with higher acne severity scores tended to have lower vitamin D3 levels, supporting the hypothesis of a negative association between vitamin D3 status and acne severity.

DISCUSSION

In the present study conducted among 139 adolescents with acne vulgaris, the majority of participants were females (51.8%), and more than two-thirds had moderate to severe acne based on GAGS scoring. This is consistent with earlier reports that adolescent females are more likely to seek medical attention for acne due to greater cosmetic concerns and psychosocial impact.[12] However, the higher prevalence in females in our study may also reflect hormonal influences during puberty, which increase sebaceous gland activity and contribute to acne development.[13]

A significant finding in our study was that the mean serum vitamin D3 level was higher in males (23.5 ± 4.8 ng/mL) compared to females (20.6 ± 4.5 ng/mL), with the difference being statistically significant (p = 0.004). This observation aligns with the work of Alhetheli et al., who also reported lower vitamin D levels among females with acne, possibly due to reduced sun exposure and sociocultural clothing practices that limit skin exposure.[14] Additionally, hormonal differences may play a role, as estrogen can modulate immune responses and sebocyte activity.[15]

Our results showed a clear inverse relationship between serum vitamin D3 levels and acne severity. Participants with mild acne had the highest mean vitamin D3 levels (26.1 ± 2.1 ng/mL), followed by moderate acne (24.5 ± 2.0 ng/mL), and severe acne (17.8 ± 1.7ng/mL), with the difference being statistically significant (p = 0.003). This trend is similar to findings from Lim et al., who demonstrated that patients with severe acne had significantly lower vitamin D levels compared to those with milder forms [16]. The possible explanation for this association lies in vitamin D's anti-inflammatory properties; it downregulates pro-inflammatory cytokines such as IL-6, IL-8, and TNF-α, which are known to play a role in acne pathogenesis.[17]

The correlation analysis in our study further confirmed these findings, with a negative correlation between serum vitamin D3 levels and GAGS score (r = –0.047, p = 0.003) in severe acne cases. Puspita et al. reported similar results, highlighting that lower serum vitamin D levels were associated with greater acne severity, and supplementation could potentially improve inflammatory acne lesions.[18]

In our study, 68.3% of participants had more than two hours of sun exposure daily, yet all had insufficient vitamin D levels. This paradox has been observed in other Indian studies and may be due to factors such as skin pigmentation, air pollution, and limited body surface exposure during sun exposure.[19] Harinarayan et al. have reported that despite abundant sunshine in India, vitamin D deficiency remains prevalent due to such environmental and lifestyle factors.[20]

The higher proportion of participants from rural areas (59.7%) in our study did not translate into significantly higher vitamin D levels compared to urban participants, suggesting that outdoor

occupation alone may not be sufficient for adequate vitamin D synthesis if other limiting factors are present. Similar observations were made by Goswami et al., who found no significant rural-urban differences in vitamin D status among Indian populations.[21]

Our findings reinforce the growing body of evidence suggesting that vitamin D3 deficiency or insufficiency may be a contributing factor in the pathogenesis of acne vulgaris. The exact mechanism may involve modulation of sebocyte activity, suppression of inflammatory cytokines, and enhancement of the skin's innate immune response.[17,18]

However, it is important to note that this study was observational and cannot establish a causal relationship. Randomized controlled trials assessing the effect of vitamin D supplementation on acne severity would be required to confirm these findings. Additionally, although our sample size was adequate, the study was conducted at a single tertiary care hospital, which may limit the generalisability of the results.

CONCLUSION

In this study of 139 adolescents with acne vulgaris, 51.8% were females and 48.2% were males, with the majority (66.9%) in the 15–19 years age group. Moderate acne was most common (36.7%), followed by severe (33.1%) and mild (30.2%) cases. The mean serum vitamin D3 level was significantly higher in males (23.5 ± 4.8 ng/mL) compared to females (20.6 ± 4.5 ng/mL; p = 0.004). Vitamin D3 levels showed a significant decreasing trend with increasing acne severity—26.0 ± 2.1 ng/mL in mild, 24.5 ± 2.0 ng/mL in moderate, and 17.8 ± 1.7 ng/mL in severe acne (p = 0.001)—and were inversely correlated with GAGS scores (r = –0.047, p = 0.003) in severe cases. These findings indicate that lower serum vitamin D3 levels are associated with greater acne severity, suggesting a potential role for vitamin D status assessment and correction as part of acne management strategies in adolescents.

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