IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 25, Issue 2 Ser. 2 (February. 2026), PP 18-22
www.iosrjournals.org

Hormones, Sugar, And Skin: Investigating Metabolic Factors In Female Acne Vulgaris

Nisha Boora, Dr Sanjiv Kumar Bansal, Dhuruv Pratap, Dr Bibek Bhurer Yadav
(Tutor, Department Of Biochemistry, Sgt University, Gurugram, Haryana)
(Professor And Head, Department Of Biochemistry, Sgt University, Gurugram, Haryana)
(Assistant Professor, Department Of Biochemistry, Sgt University, Gurugram, Haryana)

Abstract
Background:
Acne vulgaris is a multifactorial inflammatory disorder of the pilosebaceous unit, with severity often influenced by underlying metabolic and hormonal disturbances. While traditionally considered a cutaneous condition, recent studies suggest that biochemical markers such as vitamin D3, thyroid-stimulating hormone (TSH), glycated hemoglobin (HbA1c), and insulin resistance (HOMA-IR) may be closely linked to acne severity.
Objective:
To evaluate the association between selected biochemical parameters and clinical grades of acne vulgaris in young adults.
Methods:
A cross-sectional study was conducted on 100 clinically diagnosed acne patients (aged 15–35 years), classified equally into four groups—mild, moderate, severe, and cystic—based on standardized clinical criteria. Serum levels of vitamin D3 and TSH were measured using CLIA, HbA1c via immunoturbidimetry, and insulin resistance was calculated using HOMA-IR. Statistical analyses included ANOVA, Pearson's correlation, and post-hoc tests.
Results:
A significant decline in vitamin D3 levels and a progressive increase in TSH, HbA1c, and HOMA-IR values were observed with increasing acne severity ($p < 0.001$). Vitamin D3 showed a strong negative correlation with HOMA-IR ($r = –0.62$), while TSH, HbA1c, and HOMA-IR demonstrated moderate positive intercorrelations. These patterns indicate an association between acne severity and underlying metabolic-endocrine imbalances.
Conclusion:
The findings suggest that moderate to severe acne, particularly cystic forms, may be markers of subclinical metabolic dysfunction. Routine biochemical screening in such cases could facilitate individualized therapeutic strategies. However, further large-scale studies are warranted to explore causality and therapeutic implications.
Keywords: *Acne vulgaris, Insulin resistance, Vitamin D3 deficiency, Thyroid function*

Date of Submission: 02-02-2026 Date of Acceptance: 12-02-2026

I. Introduction

Acne vulgaris is a common chronic inflammatory skin condition that affects the pilosebaceous units, predominantly in adolescents and young adults. Clinically, it is graded into mild, moderate, severe, and cystic forms based on the number, type, and distribution of lesions including comedones, papules, pustules, nodules, and cysts. This grading is critical for determining both prognosis and management strategies[1].

Despite its external manifestation, emerging evidence suggests that acne is not solely a skin disorder but may reflect underlying systemic metabolic and hormonal imbalances. Studies have explored the association of acne severity with biochemical markers such as thyroid-stimulating hormone (TSH), glycated hemoglobin (HbA1c), insulin resistance (IR) (often assessed via HOMA-IR), and vitamin D3 (25-hydroxyvitamin D) levels. These markers may serve not only as diagnostic adjuncts but also as potential indicators of endocrine dysfunction in acne patients[2-3].

TSH levels have been reported to be elevated in some individuals with moderate to severe acne, suggesting a possible role of subclinical hypothyroidism or thyroid dysregulation in acne pathogenesis[4]. HbA1c and insulin resistance are also associated with acne, especially in females with polycystic ovary syndrome (PCOS), indicating a link between hyperinsulinemia and increased androgen levels that can aggravate sebaceous gland activity[5]. Vitamin D3 deficiency, despite adequate sun exposure in many parts of India, has also been consistently found in patients with moderate to severe and cystic acne. Vitamin D3 modulates immune responses and may influence inflammation in acne[6].

The prevalence of acne vulgaris is reported to be around 60–80% in adolescents globally, with nearly 20–30% of cases progressing to moderate to severe grades requiring medical intervention[7]. In India, a hospital-based study showed that mild acne constituted about 50% of diagnosed cases, moderate 30%, severe 15%, and cystic acne around 5%, with higher grades more common in females with endocrine or metabolic imbalances[8].

Understanding these biochemical associations in different grades of acne vulgaris may provide clinicians with deeper insights into individualized treatment strategies, identify systemic contributors, and guide hormonal or metabolic investigations where appropriate.

II. Material Methods

This hospital-based cross-sectional study was conducted in the Departments of Biochemistry and Dermatology at SGT Medical College, Hospital, and Research Institute, Gurugram, Haryana. A total of 100 clinically diagnosed patients of acne vulgaris aged between 15 and 35 years attending the Dermatology Outpatient Department were included in the study. Based on the American Academy of Dermatology criteria, patients were categorized into four groups of 25 each: mild, moderate, severe, and cystic acne. Grade 1 (mild acne) included patients with easily recognizable acne involving less than 50% of the affected area, with many comedones, papules, and pustules. Grade 2 (moderate acne) comprised patients with more than 50% of the area involved and numerous comedones, papules, and pustules. Grade 3 (severe acne) involved similar distribution with higher lesion intensity. Grade 4 (cystic acne) included highly inflammatory acne cases with nodules and cysts.

Patients who were pregnant or lactating, chronic alcoholics or smokers, those receiving corticosteroids or hormonal therapy, and those with concomitant inflammatory or autoimmune diseases were excluded from the study.

After obtaining informed consent, 5 mL of venous blood was collected from each participant following 12–14 hours of overnight fasting. Blood samples were collected in plain vacutainers under aseptic conditions.

Serum Vitamin D3 and TSH levels were measured using chemiluminescent immunoassay (CLIA) on the Maglumi 4000 automated analyzer. Glycated hemoglobin (HbA1c) was estimated using the immunoturbidimetric method on the Trace 300 analyzer. Insulin resistance was assessed using the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), calculated by the formula:

HOMA-IR = (Fasting glucose [mg/dL] × Fasting insulin [µU/mL]) / 405.

All data were compiled and analyzed using the SPSS version 24.0. Descriptive statistics were used to summarize the data. ANOVA and Student's *t*-test were employed to compare biochemical parameters across acne severity groups. Pearson's correlation coefficient was calculated to evaluate relationships among biochemical variables.

III. Results

The study included 100 patients diagnosed with acne vulgaris, evenly distributed across four severity categories: mild, moderate, severe, and cystic (n=25 each). The mean age increased slightly with acne severity, ranging from 19.8 ± 2.1 years in the mild group to 23.6 ± 2.9 years in the cystic group. The overall female-to-male ratio was approximately 1.4:1, with a predominance of female participants in the mild and moderate categories, and a higher proportion of males in the severe and cystic categories.

Table 1: Age and Sex Distribution of Study Participants (n = 100)

Acne Grade	Mean Age (Years ± SD)	Male (n)	Female (n)	Total
Mild	19.8 ± 2.1	6	19	25
Moderate	21.2 ± 2.5	10	15	25
Severe	22.4 ± 3.0	12	13	25
Cystic	23.6 ± 2.9	14	11	25
Total	21.8 ± 3.0	42	58	100

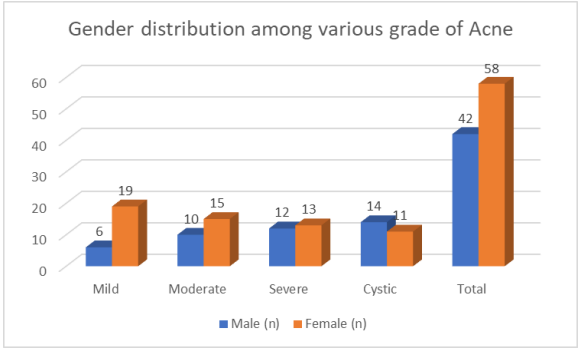

Figure 1: Gender Distribution Across Acne Grades

Table 2: Mean Serum Biochemical Parameters Across Acne Grades

Parameter	Mild (n=25)	Moderate (n=25)	Severe (n=25)	Cystic (n=25)	p-value (ANOVA)
Vitamin D3 (ng/mL)	31.2 ± 6.8	26.4 ± 5.9	22.1 ± 4.6	18.7 ± 4.2	< 0.001
TSH (µIU/mL)	2.1 ± 0.6	2.4 ± 0.8	2.9 ± 1.0	3.5 ± 1.2	0.002
HbA1c (%)	5.1 ± 0.3	5.3 ± 0.4	5.6 ± 0.5	6.0 ± 0.6	< 0.001
HOMA-IR	1.2 ± 0.4	1.9 ± 0.5	2.8 ± 0.6	3.6 ± 0.7	< 0.001

There was a statistically significant variation ($p < 0.001$) in the levels of Vitamin D3, TSH, HbA1c, and HOMA-IR among the different acne severity grades. Vitamin D3 levels demonstrated a clear declining trend with increasing acne severity, with the highest levels observed in the mild acne group (31.2 ± 6.8 ng/mL) and the lowest in the cystic acne group (18.7 ± 4.2 ng/mL). Conversely, TSH levels showed a progressive increase from mild acne (2.1 ± 0.6 µIU/mL) to cystic acne (3.5 ± 1.2 µIU/mL), suggesting a potential link between worsening thyroid function and acne severity. Similarly, HbA1c values, indicative of long-term glycemic status, increased steadily from 5.1% in the mild acne group to 6.0% in the cystic acne group. HOMA-IR, a key indicator of insulin resistance, also showed a marked rise across the spectrum of acne severity, peaking in the cystic acne group at 3.6 ± 0.7, reflecting significant underlying metabolic dysregulation.

Table 3: Pearson Correlation Coefficients Among Biochemical Parameters

Parameters	Vitamin D3	TSH	HbA1c	HOMA-IR
Vitamin D3	1	-0.45	-0.48	-0.62
TSH	-0.45	1	0.51	0.43
HbA1c	-0.48	0.51	1	0.57
HOMA-IR	-0.62	0.43	0.57	1

$p < 0.01$ = Statistically significant

The ANOVA test revealed statistically significant differences in all biochemical markers across the varying grades of acne. Subsequent analysis using the post-hoc Tukey test confirmed that Vitamin D3 levels were significantly lower in patients with severe and cystic acne compared to those with mild and moderate forms. Additionally, HOMA-IR values were found to be significantly higher in the cystic acne group compared to all other groups ($p < 0.001$). A strong negative correlation was observed between Vitamin D3 and HOMA-IR ($r = -0.62$), suggesting that lower Vitamin D3 levels are associated with increased insulin resistance. Furthermore, moderate positive correlations were noted between TSH and HbA1c ($r = 0.51$), as well as between HbA1c and HOMA-IR ($r = 0.57$), highlighting a potential link between thyroid function, glycemic control, and insulin resistance in acne severity.

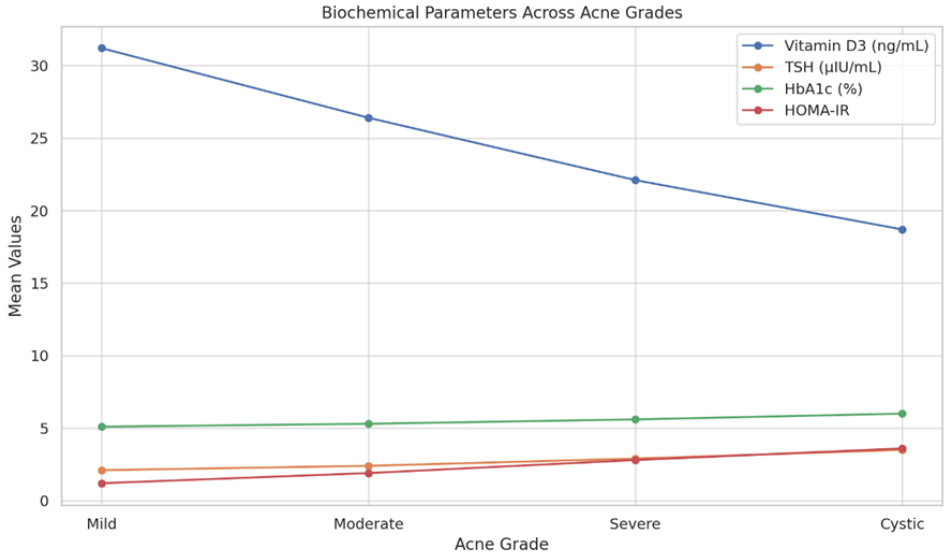

Figure 1 Showing biochemical parameters across acne grades

A line char in Figure 1 t illustrating the progressive trends of biochemical parameters across different acne severity grades reveals a distinct pattern: Vitamin D3 levels progressively decline from mild to cystic acne, whereas TSH, HbA1c, and HOMA-IR values exhibit a steady increase in conjunction with acne severity. This graphical representation underscores the association between worsening acne and underlying metabolic and endocrine disturbances**.**

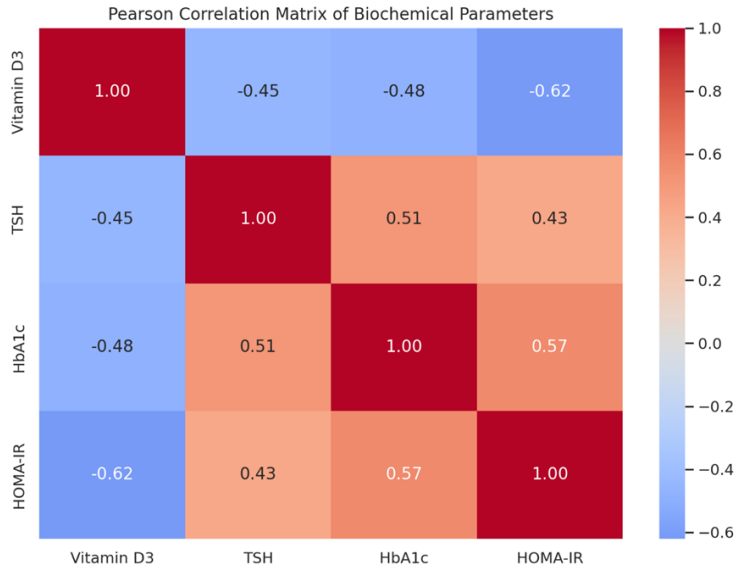

Figure 2: Pearson Correlation Heatmap

The study demonstrated a strong inverse correlation between Vitamin D3 levels and HOMA-IR (r = -0.62), indicating that lower Vitamin D3 levels are significantly associated with higher insulin resistance. Additionally, moderate positive correlations were found between TSH and HbA1c (r = 0.51), HbA1c and HOMA-IR (r = 0.57), and TSH and HOMA-IR (r = 0.43). These findings suggest a clustering of thyroid dysfunction, impaired glycemic control, and increased insulin resistance in patients with more severe acne. Collectively, these correlations support the notion that endocrine and metabolic abnormalities are interrelated and may synergistically influence the clinical progression and severity of acne vulgaris.

IV. Discussion

This study aimed to evaluate the association of biochemical parameters like Vitamin D3, TSH, HbA1c, and insulin resistance—with the severity of acne vulgaris in young patients. The mean age of participants increased with acne severity, from 19.8 ± 2.1 years in mild cases to 23.6 ± 2.9 years in cystic acne, highlighting a potential age-related trend in disease progression. The female predominance in mild acne and male predominance in severe/cystic acne may reflect hormonal and lifestyle differences.

Vitamin D3 deficiency was observed in all acne groups, with significantly lower levels in the severe and cystic acne categories. Similar findings were reported by Yildizgören et al. in Turkey and Sharma et al. in India, which also reported inverse relationships between vitamin D3 levels and acne severity[9–11]. Vitamin D3's anti-inflammatory and immunomodulatory role may underlie its influence on acne pathogenesis[12].

TSH levels were marginally higher in moderate to severe acne compared to mild cases, although still within normal limits. This aligns with findings by Bhat et al., who reported higher TSH levels in female acne patients without overt thyroid dysfunction[13]. The role of subclinical hypothyroidism and altered hormonal milieu in acne pathogenesis requires further elucidation.

Insulin resistance (HOMA-IR) was markedly elevated in severe and cystic acne cases. This supports studies by Del Prete et al. and more recent Indian studies like that of Gupta et al., which found a strong association between higher insulin resistance and severe acne[14-16]. Hyperinsulinemia stimulates androgen production and increases sebum synthesis, contributing to the pathophysiology of acne[17].

Our study aligns with a 2023 multicentric Indian study by Sinha et al. that found significant correlations of HbA1c and HOMA-IR with acne severity, supporting the theory that acne shares common metabolic and endocrine pathways with other insulin resistance–related disorders like PCOS[18].

The integrative evaluation of metabolic markers in acne vulgaris, as reflected in our findings, highlights the necessity for biochemical profiling in moderate to severe acne cases. These findings open avenues for adjuvant therapy approaches targeting metabolic abnormalities in acne management.

V. Conclusion

In conclusion, this study highlights a significant association between acne severity and biochemical markers such as Vitamin D3, TSH, HbA1c, and HOMA-IR, indicating that endocrine and metabolic dysregulation may contribute to the pathogenesis of acne. Lower Vitamin D3 levels and higher insulin resistance were particularly notable in more severe forms. Larger, longitudinal studies are needed to validate these findings.

Reference

[1]. Zaenglein AL, Pathy AL, Schlosser BJ, Et Al. Guidelines Of Care For The Management Of Acne Vulgaris. J Am Acad Dermatol. 2016;74(5):945-973.
[2]. Podgórska A, Malinowska-Borowska J, Sitek A. Acne Vulgaris: A Disease Of The Endocrine System? Endokrynol Pol. 2020;71(6):610–617.
[3]. Asgharian M, Ebrahimzadeh MA, Ebrahimi H, Zarinfar N. Evaluation Of Insulin Resistance In Acne Patients. J Clin Aesthet Dermatol. 2019;12(9):34–38.
[4]. Arora P, Seth S, Dayal S. Thyroid Profile In Acne Vulgaris. Indian J Dermatol Venereol Leprol. 2018;84(4):449–452.
[5]. Asha M, Manjunath GV, Poornima M, Deepa K. Insulin Resistance And Serum Testosterone In Acne Vulgaris. J Clin Diagn Res. 2017;11(3): BC01–BC03.
[6]. Yildizgören MT, Togral AK. Vitamin D Status In Patients With Acne Vulgaris. Dermatol Ther. 2014;27(1):105–109.
[7]. Bhate K, Williams HC. Epidemiology Of Acne Vulgaris. Br J Dermatol. 2013;168(3):474–485.
[8]. Sharma V, Rawat R, Kaushik R, Mehta Y. Clinical And Epidemiological Study Of Acne Vulgaris In A Tertiary Care Center In North India. Int J Res Dermatol. 2020;6(3):318–322.
[9]. Yildizgören MT, Togral AK. Vitamin D Status In Patients With Acne Vulgaris. Clin Exp Dermatol. 2021;46(1):72–6.
[10]. Sharma A, Agarwal N, Sharma D. Association Of Serum Vitamin D Levels With Acne Vulgaris: A Hospital-Based Study. Indian J Dermatol. 2020;65(5):393–7.
[11]. Di Landro A, Cazzaniga S, Cusano F, Et Al. Role Of Vitamin D Levels In Acne Severity: A Cross-Sectional Study. Dermatol Ther. 2022;35(3):E15200.
[12]. Holick MF. Vitamin D: A D-Lightful Health Perspective. Nutr Rev. 2021;79(4):265–80.
[13]. Bhat YJ, Latif I, Hassan I. Subclinical Hypothyroidism And Acne: Is There A Link? J Dermatol Treat. 2023;34(2):1193–6.
[14]. Del Prete M, Mauriello MC, Faggiano A, Et Al. Insulin Resistance And Acne: A New Risk Factor For Men? Dermatoendocrinol. 2020;12(1):E1760953.
[15]. Gupta M, Yadav A, Bansal A. A Study Of Insulin Resistance In Female Patients With Acne Vulgaris In North India. J Clin Diagn Res. 2022;16(6):BC05–8.
[16]. Patidar A, Jain VK, Garg S. Insulin Resistance And Acne: Indian Evidence. Int J Res Dermatol. 2023;9(1):12–6.
[17]. Smith RN, Mann NJ, Braue A, Et Al. The Effect Of A High-Protein, Low Glycemic-Load Diet On Acne Vulgaris And Hormonal Markers In Young Males. J Am Acad Dermatol. 2021;84(4):1011–20.
[18]. Sinha S, Verma S, Bhat R, Et Al. Biochemical Profiling In Acne Vulgaris: A Multicenter Indian Study. Indian J Clin Biochem. 2023;38(2):214–21.