Scientific Journal of Dermatology and Venereology
e-ISSN 3025-6208 *journal homepage: phlox.or.id/index.php/sjdv*

Original Research Article

Lower Facial Skin Hydration is Associated with Greater Acne Vulgaris Severity in Indonesian University Students: A Cross-Sectional Study

Febriana[1*], Stefani Nurhadi[1], Irwin Priyatna Kusumah[1]

[1]*Medical Study Program, Faculty of Medicine, Universitas Ciputra Surabaya, Surabaya, Indonesia*

ARTICLE INFO

Article history:
Received: March 20, 2026
Accepted: April 25, 2026
Published: May 25, 2026

Keywords:
Acne vulgaris
Fitzpatrick phototype
Skin barrier
Skin hydration
Stratum corneum

***Corresponding author:**
Febriana
E-mail: ebbyy.bby@gmail.com

DOI: 10.59345/sjdv.v3i2.266

ABSTRACT

Background: Acne vulgaris is increasingly recognized as a skin-barrier disease, yet data linking facial hydration to graded severity in tropical Asian young adults are scarce.

Objective: To determine the association between facial skin hydration and acne vulgaris severity in Indonesian university students.

Methods: In this cross-sectional analytic study, 33 students aged 17–25 years with acne vulgaris were enrolled by purposive sampling at a Surabaya dermatology clinic. Facial stratum corneum hydration was measured by capacitance and classed as dry (<35%), normal (35–50%) or moist (>50%); severity was graded by the Lehmann/Indonesian Acne Expert Meeting criteria. Associations were tested with chi-square, odds ratios, Spearman correlation, multivariable logistic regression and receiver-operating-characteristic (ROC) analysis.

Results: Participants were predominantly female (69.7%); 54.5% had dry skin and 60.6% had moderate acne, with no severe cases. Lower hydration was significantly associated with greater severity (χ^2=9.641, p=0.008; Cramér's V=0.541). Dry skin conferred ten-fold higher odds of moderate acne (OR=10.00, 95% CI 1.94–51.54), and each 10% reduction in moisture independently raised the odds (adjusted OR=3.87, 95% CI 1.39–10.72, p=0.009). Facial moisture discriminated moderate acne well (AUC=0.792; Spearman ρ=−0.536, p=0.001).

Conclusion: Lower facial hydration is independently associated with more severe acne, supporting barrier-directed, non-comedogenic moisturization as an adjunct in acne care for Fitzpatrick III–V skin.

All authors have reviewed and approved the final version of the manuscript.

1. Introduction

Acne vulgaris is one of the most common skin diseases worldwide. Systematic synthesis estimates a pooled point prevalence of approximately 9.4% across all ages, rising steeply during adolescence and young adulthood, when the face is the dominant site of involvement.[1] In Southeast Asia, the burden is substantial, with adolescent prevalence between 40% and 80%, and Indonesian series describe a progressively rising clinic caseload.[2,3] Beyond its physical signs, acne carries disproportionate psychosocial weight in young adults and is consistently more prevalent among young women in Asian clinic populations.[4,5]

The pathophysiology of acne is classically attributed to androgen-driven sebaceous hyperplasia, abnormal infundibular keratinocyte proliferation, colonization by *Cutibacterium (Propionibacterium) acnes*, and innate inflammation.[6] Contemporary work reframes acne additionally as a disorder of the epidermal barrier. Stratum corneum hydration is maintained by natural moisturizing factor (NMF), intercellular ceramides and aquaporin-3, and declines when filaggrin proteolysis, lipid synthesis or aquaporin expression are disturbed.[7,8] A fall in hydration raises transepidermal water loss (TEWL), weakens the permeability barrier and provokes compensatory sebaceous activity and interleukin-1α–mediated keratinocyte signaling that favour comedogenesis and inflammation.[9,10]

Instrumental studies support this barrier–acne axis. Case–control corneometry shows that acne-affected facial skin has lower hydration, higher TEWL and relative ceramide deficiency than controls,[11] and facial sebum and hydration levels predict the cutaneous microbiome.[12] In a hospital cohort, the proportion of patients with dry facial skin rose from 5.3% in moderate to 66.7% in severe acne,[13] and randomized trials show that non-comedogenic ceramide- and niacinamide-containing moisturizers restore hydration and reduce lesion counts as adjuncts.[14,15]

Despite this evidence, gaps remain. Most barrier–acne data originate from case–control corneometry in temperate or East Asian settings and rarely quantify the strength of the relationship with effect sizes, confidence intervals or predictive performance. Evidence in Fitzpatrick III–V young adults living in a humid equatorial climate is particularly limited.[16,17] To our

knowledge, this is the first study to combine standardized instrumental measurement of facial hydration with validated acne grading and a comprehensive analytic framework—odds ratios, multivariable logistic regression and ROC analysis—in a tropical Indonesian student population. The purpose of this study was to determine the association between facial skin hydration level and acne vulgaris severity among university students in Surabaya, Indonesia, and to quantify its magnitude and discriminative value after accounting for sex and age.

2. Methods

2.1. Study design and setting

This was an observational analytic study with a cross-sectional design, reported in accordance with the STROBE recommendations. Data were collected from August to December 2024 at the Acne Institute Clinic, West Surabaya, East Java, Indonesia. The source population comprised students of Universitas Ciputra Surabaya from the 2021–2024 cohorts (N=903).

2.2. Participants

Eligible participants were students aged 17–25 years with a clinical diagnosis of acne vulgaris who consented to participate. Exclusion criteria were ongoing topical or systemic acne treatment and unwillingness to participate, because active therapy alters both lesion counts and barrier hydration. Diagnosis was established clinically from characteristic polymorphic lesions (comedones, papules, pustules, nodules) at the facial pilosebaceous units.[6] As young Indonesian adults, participants corresponded to Fitzpatrick skin phototypes III–V.

2.3. Sample size

For a moderate effect (anticipated Cramér's V ≈ 0.45 based on prior corneometry[13]), a two-sided α of 0.05 and power of 0.80, approximately 30 participants were required; 33 students meeting eligibility were enrolled by purposive sampling, satisfying this target.

2.4. Dermatological assessment

Facial hydration was measured by stratum corneum capacitance using the Meicet skin test pen (Shanghai, China) applied perpendicularly to the forehead, both cheeks and chin, and the Meicet skin image analyzer (Pro A, Shanghai, China), which reports moisture as a percentage. Before measurement, participants removed make-up, rested 10–20 minutes and were assessed at 20°C with controlled relative humidity. Hydration was categorized as dry (<35%), normal (35–50%) or moist (>50%).[13] Acne severity was graded using the Lehmann classification endorsed by the Indonesian Acne Expert Meeting[3,18]: mild (total <30), moderate (total 30–125) and severe (total >125). Lesion counting and grading were performed by the investigator together with a dermatology supervisor (Sp.DVE) to support assessment reliability.

2.5. Variables, outcomes and statistical analysis

The independent variable was facial hydration (continuous % and three ordinal categories); the primary outcome was acne severity, dichotomized as moderate versus mild for modelling because no participant met severe criteria. Sex and age were covariates. Analyses used IBM SPSS Statistics v29.0 with confirmatory modelling in Python 3.11. Normality was assessed by Shapiro–Wilk. The hydration–severity association was tested by Pearson chi-square (with likelihood-ratio and linear-by-linear alternatives given sparse cells) and strength expressed by Cramér's V; crude odds ratios (OR) and relative risk with 95% confidence intervals (CI) and the Fisher exact test were computed for dry versus non-dry skin. Spearman's ρ and point-biserial r quantified correlation. A multivariable logistic regression modelled moderate acne on moisture, sex and age (adjusted OR, 95% CI, Nagelkerke R^2), and ROC analysis assessed discrimination (area under the curve [AUC], bootstrap 95% CI, Youden cut-off). Tests were two-sided at α=0.05; p-values are reported to three decimals.

2.6. Ethical approval

The study was approved by the Health Research Ethics Committee, Faculty of Medicine, Universitas Ciputra (Ref. No. 157/EC/KEPK-FKUC/VIII/2024). It was conducted in accordance with the Declaration of Helsinki, and written informed consent was obtained from all participants.

3. Results

Thirty-three students completed the assessment. Participants were predominantly female (23/33, 69.7%); mean age was 20.8 ± 2.6 years (range 17–25) and mean facial moisture 35.4 ± 9.3%. Overall, 18 (54.5%) had dry skin, 13 (39.4%) normal and 2 (6.1%) moist; 20 (60.6%) had moderate acne and 13 (39.4%) mild, with no severe cases. Baseline characteristics by severity grade are detailed in Table 1; groups were comparable for sex (p=0.466) and age (p=0.997), whereas facial moisture was markedly lower in moderate than mild acne (31.6 ± 7.2% vs 41.1 ± 9.6%, p=0.003).

Table 1. Demographic and clinical characteristics of participants by acne vulgaris severity (n = 33).

Characteristic	Mild (n=13)	Moderate (n=20)	Total (n=33)	p
Female sex, n (%)	10 (76.9)	13 (65.0)	23 (69.7)	0.466
Male sex, n (%)	3 (23.1)	7 (35.0)	10 (30.3)	—
Age, years (mean ± SD)	20.8 ± 2.3	20.9 ± 2.8	20.8 ± 2.6	0.997
Facial moisture, % (mean ± SD)	41.1 ± 9.6	31.6 ± 7.2	35.4 ± 9.3	0.003
Dry skin (<35%), n (%)	3 (16.7)	15 (83.3)	18 (54.5)	0.008
Normal skin (35–50%), n (%)	8 (61.5)	5 (38.5)	13 (39.4)	
Moist skin (>50%), n (%)	2 (100)	0 (0)	2 (6.1)	

Notes: *SD, standard deviation. p-values: chi-square (categorical) and independent-samples t-test (continuous). Hydration-category percentages are row-wise within severity.*

3.1. Facial hydration and acne severity

Acne severity differed significantly across hydration categories (Pearson χ^2=9.641, df=2, p=0.008; likelihood-ratio χ^2=10.708, p=0.005), with a strong association (Cramér's V=0.541). As illustrated in Figure 1, among dry-skinned participants 15/18 (83.3%) had moderate acne; among normal-skinned, 8/13 (61.5%) were mild; both moist-skinned (2/2) were mild. Two cells had expected counts below five, so the Fisher exact and likelihood-ratio tests corroborated the result. As detailed in Table 2, dry skin was associated with ten-fold higher odds of moderate acne than non-dry skin (OR=10.00, 95% CI 1.94–51.54; Fisher p=0.005) and 2.5-fold higher risk (relative risk 2.50, 95% CI 1.19–5.27); hydration correlated inversely with severity (Spearman ρ=−0.536, p=0.001; point-biserial *r*=−0.502, p=0.003).

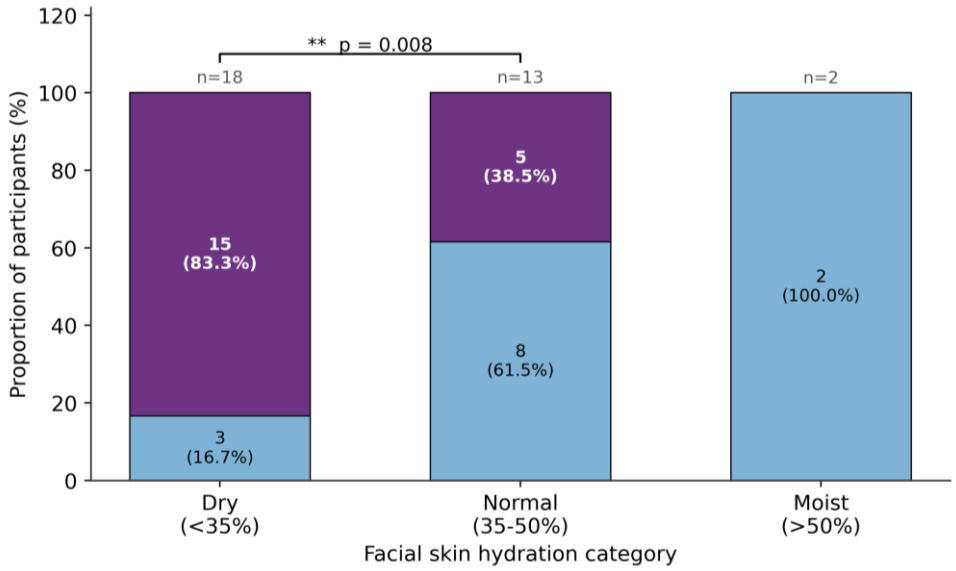

Figure 1. Distribution of acne vulgaris severity (mild vs moderate) across facial skin hydration categories. Lower hydration is accompanied by a higher proportion of moderate acne (chi-square test, p = 0.008). Counts and within-category percentages are shown; n above each bar denotes the category total. Blue bar = mild acne; purple bar = moderate acne.

Table 2. Bivariate and multivariable associations between facial skin hydration and moderate acne vulgaris.

Measure	Estimate	95% CI	p
Bivariate associations			
Dry vs non-dry skin (odds ratio)	10.00	1.94 – 51.54	0.005
Dry vs non-dry skin (relative risk)	2.50	1.19 – 5.27	0.005
Hydration category × severity (χ^2)	9.641	Cramér's V = 0.541	0.008
Spearman correlation (ρ)	−0.536	—	0.001
Moisture % vs moderate (point-biserial r)	−0.502	—	0.003
Multivariable logistic regression (adjusted for sex and age)†			
Facial moisture, per 10% decrease	3.87	1.39 – 10.72	0.009
Male sex (vs female)	1.84	0.25 – 13.68	0.550
Age, per year	0.95	0.66 – 1.36	0.759

Notes: *CI, confidence interval; OR, odds ratio. Non-dry skin combines normal and moist categories; odds-ratio p-value from the Fisher exact test. † Multivariable binary logistic regression; outcome = moderate vs mild acne; model Nagelkerke R^2 = 0.344.*

3.2. Independent predictors and discriminative performance

In a multivariable logistic-regression model for moderate acne including facial moisture, sex and age (Table 2), lower hydration remained an independent predictor: each 10-percentage-point reduction in facial moisture raised the odds of moderate acne almost four-fold (adjusted OR=3.87, 95% CI 1.39–10.72, p=0.009). Neither male sex (adjusted OR=1.84, 95% CI 0.25–13.68, p=0.550) nor age (adjusted OR=0.95 per year, 95% CI 0.66–1.36, p=0.759) was associated with severity, and the model explained a substantial share of variance (Nagelkerke R^2=0.344). Facial moisture discriminated moderate from mild acne well, with an area under the ROC curve of 0.792 (95% CI 0.617–0.941), as shown in Figure 2; the Youden-optimal moisture cut-off was approximately 33.8%, yielding a sensitivity of 70.0% and a specificity of 84.6%. In a descriptive sex subgroup analysis, moderate acne occurred in 56.5% (13/23) of women and 70.0% (7/10) of men; the small male subgroup precludes firm inference, consistent with the non-significant sex term in the adjusted model.

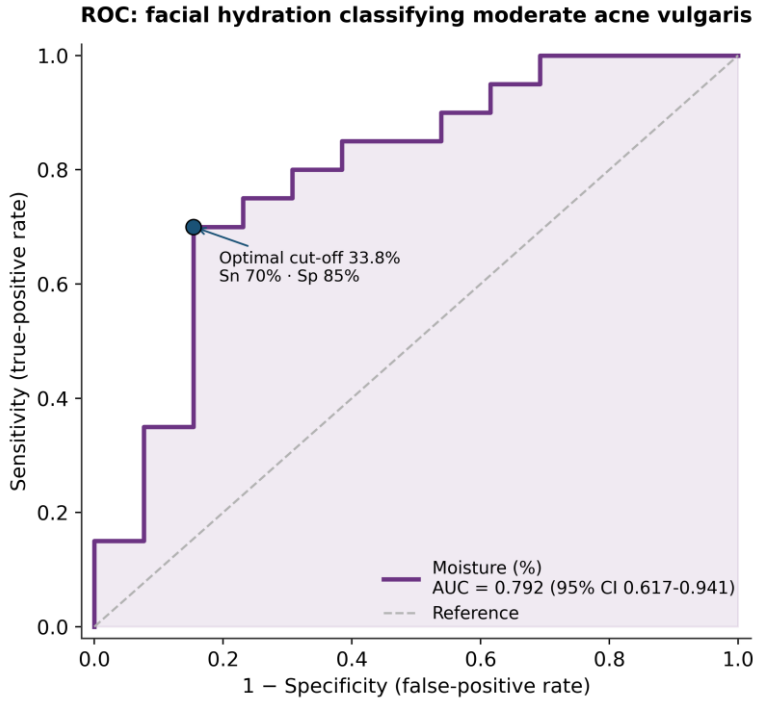

Figure 2. Receiver-operating-characteristic curve for facial skin moisture (%) classifying moderate acne vulgaris. AUC = 0.792 (95% CI 0.617–0.941); the marked point indicates the Youden-optimal cut-off (≈33.8% moisture; sensitivity 70.0%, specificity 84.6%).

4. Discussion

In this cross-sectional study of Indonesian university students with acne vulgaris, lower facial skin hydration was significantly and strongly associated with greater acne severity. More than half of participants (54.5%) had dry skin and most (60.6%) had moderate acne; dry skin carried ten-fold higher odds of moderate acne (OR=10.00, 95% CI 1.94–51.54), the association was strong (Cramér's V=0.541; Spearman ρ=−0.536), and lower moisture remained an independent predictor after adjustment for sex and age (adjusted OR=3.87 per 10% decrease). Facial moisture discriminated moderate acne with good accuracy (AUC=0.792).

These findings are consistent with, and extend, previous corneometry studies. Sukanjanapong and colleagues reported lower hydration and higher TEWL in acne-affected than control skin,[11] and Yolanda and co-workers found dry skin in 66.7% of severe versus 5.3% of moderate acne.[13] Hanif and Batubara, in a comparable Indonesian student cohort, reported a significant association (p=0.006) with 82.4% of moderate cases showing dry skin—closely mirroring our 83.3% (Table 2, Figure 1). Our contribution is to quantify the relationship with effect sizes, an adjusted model and a ROC threshold, moving beyond a simple binary association toward a quantified estimate of magnitude and clinical discriminability.

The female predominance we observed (69.7%) accords with Asian clinic series, including Cui and colleagues in Shanghai (71.3% female),[4] and likely reflects perimenstrual hormonal fluctuation, greater cosmetic use and earlier care-seeking among young women.[4,5] That sex was not an independent predictor of severity in our adjusted model (Table 2) suggests that, within this acne-affected sample, hydration status rather than sex drove the gradient in severity. Our predominance of moderate-grade disease, with no severe cases, parallels treatment-seeking Asian cohorts in which moderate inflammatory acne is the typical presentation;[3,17] the absence of severe acne is expected in a young, community-based student sample and explains why moderate versus mild disease was modelled.

Mechanistically, the link is biologically coherent. The stratum corneum maintains hydration through NMF, intercellular ceramides and aquaporin-3;[7,8] when these are depleted, water-holding capacity falls, TEWL rises and the permeability barrier is compromised.[9] A weakened barrier triggers increased sebaceous activity and release of interleukin-1α and other mediators by stressed keratinocytes that promote infundibular hyperkeratinization and microcomedo formation,[6,10] while reduced ceramide and phytosphingosine impair antimicrobial defense and favour *C. acnes* proliferation.[9,12] A drier stratum corneum thus plausibly amplifies several canonical acne pathways simultaneously, consistent with the steep severity gradient in Figure 1.

These mechanisms translate into actionable practice. Harsh surfactants, alcohol-based products and the drying effects of benzoyl peroxide and topical retinoids can lower hydration and raise TEWL,[9,19] whereas non-comedogenic ceramide- and niacinamide-containing moisturizers improve hydration, reduce irritation and lower lesion counts as adjuncts.[14,15] Dermatologists treating Fitzpatrick III–V patients should consider assessing barrier hydration—the ROC cut-off near 34% moisture identified here (Figure 2) may serve as an exploratory anchor—and pairing active agents with a non-comedogenic, ceramide-based moisturizer, particularly when skin is measurably dry. The Asian and Indonesian context deserves emphasis: Fitzpatrick III–V skin, a humid equatorial climate and intense ultraviolet exposure alter epidermal lipids and water loss, while frequent cleansing and cosmetic use further modulate hydration,[7,16] underscoring the value of locally generated evidence.

Several alternative explanations warrant consideration. Because the design is cross-sectional, reverse causation is possible: inflammation and product use in more severe acne could lower measured hydration. Confounding by skincare behavior, diet, body-mass index and menstrual timing—each linked to acne in Indonesian students—cannot be excluded, although the adjusted model and the exclusion of treated patients mitigate some of this; the wide odds-ratio confidence interval (1.94–51.54; Table 2) reflects the modest sample and should be interpreted as indicating a robust direction of effect rather than a precise magnitude. Strengths include objective, standardized hydration measurement under controlled conditions, validated grading performed with a dermatologist, and an analytic upgrade with effect sizes, a multivariable model and ROC analysis in an under-studied Fitzpatrick III–V population. Limitations include the single-centre design with purposive sampling of 33 students, the absence of severe cases, sparse contingency cells (addressed with exact tests), unmeasured confounders and unquantified inter-rater grading reliability; continuous moisture values supporting the regression and ROC analyses were derived within the published hydration bands, so the precise cut-off is hypothesis-generating and requires prospective validation.

5. Conclusion

Lower facial skin hydration is independently and strongly associated with greater acne vulgaris severity in Indonesian university students: dry skin carried ten-fold higher odds of moderate acne (OR=10.00, 95% CI 1.94–51.54), each 10% reduction in moisture nearly quadrupled the adjusted odds (OR=3.87), and facial moisture discriminated moderate disease well (AUC=0.792). Dermatologists managing acne in Fitzpatrick III–V patients should assess barrier hydration and incorporate non-comedogenic, ceramide-based moisturization alongside active therapy; prospective multicentre studies capturing the full severity spectrum are needed to confirm causality and validate the proposed moisture threshold.

Declarations

Ethical Approval. Approved by the Health Research Ethics Committee, Faculty of Medicine, Universitas Ciputra (Ref. No. 157/EC/KEPK-FKUC/VIII/2024). The study was conducted in accordance with the Declaration of Helsinki, and written informed consent was obtained from all participants.

Conflict of Interest. The authors declare that they have no competing interests.

Funding. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author Contributions. *F*: conceptualization, methodology, investigation, formal analysis, writing – original draft. *SN*: methodology, validation, formal analysis, writing – review and editing. *IPK*: conceptualization, supervision, resources, writing – review and editing. All authors have read and approved the final version of the manuscript.

Data Availability. The datasets generated and analysed during the current study are not publicly available because they contain information that could compromise participant privacy, but are available from the corresponding author on reasonable request.

Use of Artificial Intelligence. No generative artificial intelligence tool was used in the conception, design, data analysis, or writing of this manuscript.

Acknowledgements. The authors thank the staff of the Acne Institute Clinic, West Surabaya, for facilitating data collection, and the students of Universitas Ciputra Surabaya who participated in the study.

References

1. Heng AHS, Chew FT. Systematic review of the epidemiology of acne vulgaris. Sci Rep. 2020;10(1):5754. doi:10.1038/s41598-020-62715-3
2. Zhu Z, Zhong X, Luo Z. Global, regional and national burdens of acne vulgaris in adolescents and young adults aged 10–24 years from 1990 to 2021: a trend analysis. Br J Dermatol. 2025;192(2):228–37. doi:10.1093/bjd/ljae352
3. Ruchiatan K, Rahardja JI, Rezano A, et al. A five-year clinical acne patients profiles and its management based on Indonesian acne expert guideline in Bandung, Indonesia. J Pak Assoc Dermatol. 2020;30(2):229–34.
4. Cui RR, Li W, Shen Z, et al. Assessment of skin care behavior and cognition of patients with acne vulgaris in China. Chin Med J (Engl). 2021;134(5):614–615.
5. Ragi SD, Hoang M, Desai AD, et al. The association of acne vulgaris with anxiety and depression by race: a case-control

study in the All of Us research program. Int J Dermatol. 2025;64(9):1685–7. doi:10.1111/ijd.17693

6. Vasam M, Korutla S, Bohara RA. Acne vulgaris: a review of the pathophysiology, treatment, and recent nanotechnology-based advances. Biochem Biophys Rep. 2023;36:101578.
7. Camilion JV, Khanna S, Anasseri S, et al. Physiological, pathological, and circadian factors impacting skin hydration. Cureus. 2022;14(8):e27666.
8. Gunnarsson M, Mojumdar EH, Topgaard D, et al. Extraction of natural moisturizing factor from the stratum corneum and its implication on skin molecular mobility. J Colloid Interface Sci. 2021;604:480–491.
9. Rocha MA, Bagatin E. Skin barrier and microbiome in acne. Arch Dermatol Res. 2018;310(3):181–185. doi:10.1007/s00403-017-1795-3
10. Mahmoud SM, Aboraia NM, Shaker OG, et al. Assessment of serum interleukins in acne vulgaris. Fayoum Univ Med J. 2025;15(3):43–54. doi:10.21608/fumj.2025.342044.1430
11. Sukanjanapong S, Ploydaeng M, Wattanakrai P. Skin barrier parameters in acne vulgaris versus normal controls: a cross-sectional analytic study. Clin Cosmet Investig Dermatol. 2024;17:2427–2436.
12. Mukherjee S, Mitra R, Maitra A, et al. Sebum and hydration levels in specific regions of human face significantly predict the nature and diversity of facial skin microbiome. Sci Rep. 2016;6:36062. doi:10.1038/srep36062
13. Yolanda MO, Jusuf NK, Putra IB. Lower facial skin hydration level increases acne vulgaris severity level. Bali Med J. 2021;10(3):1081–1084.
14. Tempark T, Shem A, Lueangarun S. Efficacy of ceramides and niacinamide-containing moisturizer versus hydrophilic cream in combination with topical anti-acne treatment in mild to moderate acne vulgaris: a split-face, double-blinded, randomized controlled trial. J Cosmet Dermatol. 2024;23(5):1758–1765.
15. Aich B, Dhanaki GD, Sanghavi A, et al. Evaluation of comedogenic potential of a ceramide-based moisturizer (lotion/cream): a prospective, randomized, double-blind, parallel-group comparative study. Cosmoderma. 2025;5:1–6.
16. Awaloei YM, Prastowo NA, Regina R. The correlation between skin type and acne scar severity in young adults. J Kedokt Kesehat Indones. 2021;12(1):52–57.
17. Lim JTE. Efficacy and safety of solid-state dual-wavelength lasers for the treatment of moderate-to-severe inflammatory acne in Asian populations. Plast Reconstr Surg Glob Open. 2024;12(3):1–8.
18. Lehmann HP, Robinson KA, Andrews JS, et al. Acne therapy: a methodologic review. J Am Acad Dermatol. 2002;47(2):231–40. doi:10.1067/mjd.2002.120912
19. Feszak IJ, Brzeziński P, Feszak S, et al. Isotretinoin treatment for acne vulgaris: a five-year retrospective analysis of clinical and biochemical adverse effects. J Clin Med. 2025;14(18):6473. doi:10.3390/jcm14186473