

Lower facial skin hydration level increases acne vulgaris severity level



Maya Oktari Yolanda^{1*}, Nelva Karmila Jusuf², Imam Budi Putra²

¹Postgraduate Masters in Clinical Medicine, Department of Dermatology and Venereology, Faculty of Medicine, Universitas Sumatra Utara, Universitas Sumatra Utara Hospital, Medan, Indonesia

²Department of Dermatology and Venereology, Faculty of Medicine, Universitas Sumatra Utara, Universitas Sumatra Utara Hospital, Medan, Indonesia

*Corresponding to:

Maya Oktari Yolanda; Postgraduate Masters in Clinical Medicine, Department of Dermatology and Venereology, Faculty of Medicine, Universitas Sumatra Utara, Universitas Sumatra Utara Hospital, Medan, Indonesia;

mahatama262@gmail.com

Phone No.: +6281213460612

Received: 2021-07-20

Accepted: 2021-11-28

Published: 2021-12-30

ABSTRACT

Backgrounds: Acne vulgaris is a chronic sebaceous gland inflammatory disorder that predominantly affects adolescents and young adults. Increased sebum, alterations in follicular keratinization, *Cutibacterium acnes* colonization, and inflammation are the critical pathways in the pathogenesis of acne vulgaris. Facial skin hydration can affect the primary pathogenesis mechanism of acne vulgaris. This study aimed to examine the correlation between the level of facial skin hydration and the severity of acne vulgaris.

Methods: This study was an observational analytical study of 40 subjects with acne vulgaris and 40 subjects without acne vulgaris, using a cross-sectional design. The subjects' facial skin hydration was analyzed using a CM 825 corneometer, and the severity of acne vulgaris was assessed based on Lehmann's criteria. Data were analyzed using the Spearman correlation test. Health Research Ethics Committee of the Faculty of Medicine at the University of North Sumatra has approved this study.

Results: Of the 40 subjects with acne vulgaris, women dominated (65 %) with a mean age of 19.6 ± 1.86 years old. Most subjects had moderate (50 %) degrees of acne vulgaris, followed by mild (42.5 %) and severe (7.5 %) degrees. In acne vulgaris subjects, the considered normal level of facial skin hydration was 92.5 %. The facial skin hydration found in acne vulgaris subjects was lower than non-acne vulgaris subjects with a p-value of 0.002. The degree of facial skin hydration is associated with the severity of acne vulgaris with moderate strength correlation values ($p < 0.001$, $r = -0.453$).

Conclusions: A significant correlation exists between the level of hydration of the facial skin and the severity of acne vulgaris. The lower facial skin hydration level could promote the more severe form of acne vulgaris.

Keywords: acne vulgaris, skin hydration, severity.

Cite This Article: Yolanda, M.O., Jusuf, N.K., Putra, I.B. 2021. Lower facial skin hydration level increases acne vulgaris severity level. *Bali Medical Journal* 10(3): 1081-8084. DOI: 10.15562/bmj.v10i3.2195

INTRODUCTION

Acne vulgaris (AV) is a chronic inflammatory disease of the skin's sebaceous glands with polymorphic manifestations of blackheads, papules, pustules, nodules, or cysts.¹ Studies found that about 90% of men and 80% of women had experienced AV, particularly in adolescents and young adults.² There are four fundamentals of AV pathogenesis: increased sebum production, follicular keratinization changes, *Cutibacterium acnes* (C. acnes) bacteria colonization, and inflammation. The mechanisms of AV are still being investigated up to this point.³

The balance of skin hydration and sebum is also thought to influence comedogenesis. Skin with less than 10% moisture content could result in impaired stratum corneum and inflammatory cytokine production. Therefore, adequate water content (10-20 %) is essential in

acne vulgaris prevention.⁴⁻⁶

A study by Yamamoto et al. found that AV was more common in the skin with higher trans-epidermal water loss (TEWL) and sebum secretion, and lower stratum corneum hydration. The increase in TEWL was observed to show a more severe form of AV. Therefore, it is estimated that TEWL-affected skin hydration is also a determinant of AV occurrence and could affect the degree of AV severity.⁷

Moisturizer application has been shown to have good efficacy in AV management.¹ This study aimed to determine the correlation between the level of facial skin hydration and the degree of AV severity so that skin hydration's role in AV pathogenesis could be evaluated.

METHOD

This study had obtained ethical clearance from the Research Ethics Committee of the

Faculty of Medicine, Universitas Sumatera Utara/H. Adam Malik Hospital with letter number 225/TGL/KEPK FK USU-RSUP HAM/2020 dated March 12, 2020. This study was a cross-sectional study with a consecutive sampling method involving AV and non-AV subjects, consisting of 40 people in each group according to minimum sample size calculation. The study was started from August 2020 to December 2020 at the Faculty of Medicine, University of North Sumatra. The diagnosis of acne vulgaris was based on patients' history, dermatology, and physical examinations.

The inclusion criteria for AV groups were: aged 18-25 years, willing to participate in the study, and signed a consent letter. AV subjects who were pregnant, breastfeeding, or who had received previous systemic or topical treatments in the last month were excluded from the study. We also excluded: 1)

patients who used face moisturizers for more than two weeks; 2) an active smoker for about five years with an average of one pack of cigarettes daily; 3) used hormonal contraception; 4) have dermatoses such as atopic dermatitis, ichthyosis, psoriasis, and xerosis. Subjects without acne vulgaris also had the same inclusion and exclusion criteria as the AV subjects.

The patient demographic data collected were age, gender, telephone number, and address. Determination of the AV degree was based on the acne Grading Indonesian acne Expert Meeting 2015 by Lehmann. After then, skin hydration tests using a CM 825 corneometer were performed three times each on the left cheek, right cheek, forehead, and chin. The mean value of skin hydration from each location and all examinations were calculated. Using the Spearman correlation test, the collected data were statistically analyzed to evaluate the correlation between the level of facial skin hydration and the degree of AV.

RESULTS

Characteristics of the subjects included in this study were gender and age from each group. In 40 AV subjects, it was found that there were more females (65 %) than males (35 %), as described in [Table 1](#) with a mean age of 19.60 ± 1.86 years old.

Subject distribution based on the degree of severity of AV is described in [Table 2](#). Most subjects in this study (50%, 20 of 40) had a moderate AV degree, followed by mild degree and severe degree (42,5%, 17 subjects, and 7,5%, three subjects, respectively). AV subjects had a relatively good level of facial skin hydration in 37 subjects (92.5%) with mean hydration of 62.90 ± 7.87 AU, described in [Table 3](#).

The mean facial skin hydration level in the AV group was lower (61.20 ± 9.69 AU) than the non-AV group (66.73 ± 5.25 AU). Based on the T Independent test, it was observed that there was a significant difference in the mean value of facial skin hydration level between AV and non-AV subjects ($p = 0.002$), which is described in [Table 4](#).

The correlation between the hydration level of the facial skin and AV's degree can be seen in [Table 5](#). A Spearman correlation test analysis found a significant association between skin hydration level and severity

Table 1. Subjects Characteristics Based on Sex

Sex	Acne vulgaris		Without acne vulgaris	
	n	%	n	%
Male	14	35	14	35
Female	26	65	26	65
Total	40	100	40	100

Table 2. The proportion of patients with a mild, moderate, and severe degree of acne vulgaris

The severity of Acne Vulgaris	Study Subjects	
	Amount (n)	Percentage (%)
Mild	17	42,5
Moderate	20	50
Severe	3	7,5
Total	40	100

Table 3. The proportion of facial skin hydration in patients with acne vulgaris

Level of Facial Skin Hydration	Mean \pm SD	Subjects with Acne vulgaris	
		Amount (n)	Percentage (%)
Good	$62,90 \pm 7,87$ AU	37	92,5
Dry	$40,24 \pm 2,26$ AU	3	7,5
Very Dry	0	0	0

Table 4. The difference in facial skin hydration between acne vulgaris and non-acne vulgaris

Facial Skin Hydration	Mean \pm SD	p
Acne vulgaris	$61,20 \pm 9,69$ AU	0,002
Without acne vulgaris	$66,73 \pm 5,25$ AU	

Table 5. The correlation between the level of facial skin hydration with the severity of acne vulgaris

Variables	Without Acne vulgaris (n%)	Acne Vulgaris Severity (n%)			(r)	p
		Mild	Moderate	Severe		
Hydration Level						
Good	40 (100)	18 (100)	18 (94,7)	1 (33,3)	-0,453	<0,001
Dry	0	0	1 (5,3)	2 (66,7)		
Very Dry	0	0	0	0		
Total	40	18	19	3 (7,5)		

of AV with a negative and moderate strength correlation ($p = <0.001$), $r = -0.453$). This analysis means that a lower level of facial skin hydration would cause a more severe AV degree.

DISCUSSION

Of the 40 research subjects, most AV patients were female, with the mean age being 19.60 ± 1.86 . The prevalence of AV in women was higher compared to

men in studies conducted by Zohra et al. (62.5%), Jusuf et al. (65%), Puspita et al. (80%), and Rahmayani et al. (60.6%).⁸⁻¹¹ Hormonal fluctuations throughout the menstrual cycle probably play a major role in the onset of AV in women by up to 85%. Besides, women are also affected by comedogenic cosmetics, stress factors that trigger an increase in cortisol and androgens, and their physical appearance concern.^{12,13}

Research in India found that the mean age of AV patients was 19.78 ± 4.94 years.¹⁴ In Medan, AV incidence was the highest among people between the ages of 18-25.¹⁵ AV prevalence increases with age. The prevalence of AV is 76.7%, 88.2%, and 97.1% in the age group of 10-13 years, 14-16 years, and 17-19, respectively.¹⁶ It will gradually decline to 8% in people aged 25-34 years and 3% in 35-44 years.¹⁷ High levels of androgens during puberty cause increased secretion of sebum, resulting in abnormal desquamation and follicular obstruction of the skin.^{18,19}

Most subjects in this study (50%, 20 of 40) had a moderate AV degree, followed by mild degree and severe degree (42.5%, 17 subjects, and 7.5%, three subjects, respectively). The higher prevalence of AV with moderate severity was also found in studies by Zofra et al. (41.67%), Hidayati et al. (81.4%),¹⁸ Sutristo et al. (45%), and Yutrishia et al. (59.3%).^{8,20-22} In contrast to the study, Yahya et al., Shen et al., and El-Hamd et al. found that the prevalence of AV with mild severity was higher than other types of severity (93.1%, 68.4%, 53%, respectively).^{16,23,24}

According to the severity, the different proportions of AV can differ due to differences in subjects' age. It might be related to the peak serum DHEAS hormone concentration at the age of 20-30. Testosterone, as the DHEAS metabolite, will be converted into DHT and will stimulate sebum production. This excessive production of sebum is closely associated with AV severity.²⁵ Also, with a more common form of inflammatory lesion than the blackhead types, Asians tend to develop the more severe conditions of AV lesions.^{18,26}

The majority of AV subjects in this study (92.5%, 37 of 40) had a relatively good facial skin hydration level with mean hydration of 62.90 ± 7.87 AU. These findings were in line with other studies conducted by Kmiec et al., Inui et al., and Kantikosum et al., that also found good facial skin hydration in their AV subjects with a mean value of 56.9 ± 6.84 AU, 51.7 ± 7.9 AU, and 45.17 ± 9.31 AU, respectively.²⁷⁻²⁹

Assessment of skin hydration using a corneometer can detect hydration ranging from 0 AU (no water) to 120 AU (pure water). Skin usually shows values ranging

from <30 AU (very dry), 30-45 AU (dry), and > 45 AU (good).^{30,31} A well-functioned water loss barrier of the stratum corneum will reflect well-hydrated skin.³² The most common skin condition, acne vulgaris, is usually associated with loss of barrier structure and function.³³ Inflammatory AV lesions are said to be associated with the impaired stratum corneum barrier.³⁴

The mean facial skin hydration in the subject group with AV was lower than that of the non-AV subject group (61.20 ± 9.69 AU vs. 66.73 ± 5.25 AU). In contrast to these findings, Zhou et al. found that facial skin hydration in AV patients was higher than non-AV subjects (55.07 ± 7.4 AU vs. 52.3 ± 6.18 AU). However, the results were not significant ($p > 0.05$), and they did not exclude subjects who had used facial moisturizers before the assessment.³⁵

All non-AV subjects (100%) and all subjects with mild AV (100%) had good skin hydration. In moderate AV, 94.7% of subjects had good skin hydration levels, while only 33.3% of severe AV subjects had good skin hydration. Well-hydrated skin will help boost the development of commensal bacteria in the skin.³⁶ The decrease in sphingolipids and ceramides in AV patients resulted in the deficiency of intracellular membrane lipids and impaired stratum corneum barrier permeability. Moreover, TEWL increase could also cause decreased hydration in AV patients.^{6,7}

Also, the decrease in phytosphingosine, which plays an essential role in the skin's permeability and antimicrobial defense, could cause alteration in the skin barrier, promote inflammation and infection, and impair the water barrier function of the skin.³⁷ Decreased level of skin hydration, cracked skin, and desquamation will clinically cause changes in the skin barrier's function, facilitating the invasion of pathogens in the pilosebaceous unit that has been shown to cause inflammatory reactions.^{38,39}

This study showed a significant correlation between the level of skin hydration and the degree of AV severity. In other words, a lower level of facial skin hydration could promote a more severe form of AV. This relationship has a negative correlation value and a moderate strength ($p = <0.001$, $r = -0.453$). These results were in line with previous studies

by Yamamoto et al. that found a significant decrease in facial skin hydration among 65 AV patients.⁷

Isoda et al. also found that lesions in mild AV patients were significantly reduced after treated with facial washes and moisturizers containing pseudo ceramides and eucalyptus extracts that promote skin hydration improvement and increased levels of endogenous ceramides in the corneum layer significantly.⁴⁰

CONCLUSIONS

This present study found a significant correlation between the level of skin hydration and the degree of AV severity. The lower facial skin hydration level could promote the more severe form of AV lesions.

DISCLOSURE

ACKNOWLEDGMENT

We like to thank the Head of the Department of Dermatology and Venereology, Faculty of Medicine, University of North Sumatra, and the University of North Sumatra Hospital.

AUTHOR'S CONTRIBUTION

All authors contributed to the entire research process, including preparation, data collection and analysis, and approval for publication of this manuscript.

FUNDING

The author is liable for all research funding without any grant involvement or external funding source.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest related to this article publication.

REFERENCES

- Goh CL, Abad-Casintahan F, Aw DCW, Baba R, Chan LC, Hung NT, et al. South-East Asia study alliance guidelines on the management of acne vulgaris in South-East Asian patients. *J Dermatol.* 2015;42(10):945-53. Available from: <http://dx.doi.org/10.1111/1346-8138.12993>
- Alanazi MS, Hammad SM, Mohamed AE. Prevalence and psychological impact of Acne vulgaris among female secondary

- school students in Arar city, Saudi Arabia, in 2018. *Electron physician*. 2018;10(8):7224–9. Available from: <https://pubmed.ncbi.nlm.nih.gov/30214705>
3. Chularojanamontri L, Tuchinda P, Kulthanan K, Pongparit K. Moisturizers for acne: What are their constituents? *J Clin Aesthet Dermatol*. 2014;7(5):36.
 4. Ezerskaia A, Pereira SF, Urbach HP, Verhagen R, Varghese B. Quantitative and simultaneous non-invasive measurement of skin hydration and sebum levels. *Biomed Opt Express*. 2016;7(6):2311–20. Available from: <https://pubmed.ncbi.nlm.nih.gov/27375946>
 5. Lynde C. Moisturizers for the treatment of inflammatory skin conditions. *J drugs dermatology JDD*. 2008;7(11):1038–43.
 6. Thiboutot D, Del Rosso JQ. Acne vulgaris and the epidermal barrier: is acne vulgaris associated with inherent epidermal abnormalities that cause impairment of barrier functions? Do any topical acne therapies alter the structural and/or functional integrity of the epidermal barrier? *J Clin Aesthet Dermatol*. 2013;6(2):18.
 7. Yamamoto A, Takenouchi K, Ito M. Impaired water barrier function in acne vulgaris. *Arch Dermatol Res*. 1995;287(2):214–8. Available from: <http://dx.doi.org/10.1007/bf01262335>
 8. Sultana T. Evaluation of Severity in Patients of Acne Vulgaris by Global Acne Grading System in Bangladesh. *Clin Pathol Res J*. 2017;1(1). Available from: <http://dx.doi.org/10.23880/cprj-16000105>
 9. Jusuf NK, Putra IB, Sari L. Differences of microbiomes found in non-inflammatory and inflammatory lesions of acne vulgaris. *Clin Cosmet Investig Dermatol*. 2020;13:773.
 10. Puspita F, Simanungkalit R, Yosi A. Correlation between Serum 25-Hydroxyvitamin D Level with Acne Vulgaris Severity. *Int J Sci Res Publ*. 2020;10(1):p9750. Available from: <http://dx.doi.org/10.29322/ijsrp.10.01.2020.p9750>
 11. Rahmayani T, Putra IB, Jusuf NK. The Effect of Oral Probiotic on the Interleukin-10 Serum Levels of Acne Vulgaris. *Open access Maced J Med Sci*. 2019;7(19):3249–52. Available from: <https://pubmed.ncbi.nlm.nih.gov/31949525>
 12. Zeichner JA, Baldwin HE, Cook-Bolden FE, Eichenfield LF, Friedlander SF, Rodriguez DA. Emerging issues in adult female acne. *J Clin Aesthet Dermatol*. 2017;10(1):37.
 13. Khunger N, Kumar C. A clinico-epidemiological study of adult acne: Is it different from adolescent acne? *Indian J Dermatology, Venereol Leprol*. 2012;78(3):335. Available from: <http://dx.doi.org/10.4103/0378-6323.95450>
 14. Abo El-Fetoh NM, Alenezi NG, Alshamari NG, Alenezi OG. Epidemiology of acne vulgaris in adolescent male students in Arar, Kingdom of Saudi Arabia. *J Egypt Public Health Assoc*. 2016;91(3):144–9. Available from: <http://dx.doi.org/10.1097/01.epx.0000492401.39250.62>
 15. Dewi NK, Putra IB, Jusuf NK. Passion fruit purple variant (*Passiflora edulis Sims var. edulis*) seeds extract 10% cream in acne vulgaris treatment: an open-label pilot study. *Int J Dermatol*. 2020;59(12):1506–12. Available from: <http://dx.doi.org/10.1111/ijd.15178>
 16. Yahya H. Acne vulgaris in Nigerian adolescents - prevalence, severity, beliefs, perceptions, and practices. *Int J Dermatol*. 2009;48(5):498–505. Available from: <http://dx.doi.org/10.1111/j.1365-4632.2009.03922.x>
 17. White GM. Recent findings in the epidemiologic evidence, classification, and subtypes of acne vulgaris. *J Am Acad Dermatol*. 1998;39(2):S34–7. Available from: [http://dx.doi.org/10.1016/s0190-9622\(98\)70442-6](http://dx.doi.org/10.1016/s0190-9622(98)70442-6)
 18. Sutaria AH, Masood S, Schlessinger J. Acne Vulgaris. *StatPearls*. 2021; Available from: <https://www.ncbi.nlm.nih.gov/books/NBK459173/>
 19. Dawson AL, Dellavalle RP. Acne vulgaris. *BMJ*. 2013;346(may08 1):f2634–f2634. Available from: <http://dx.doi.org/10.1136/bmj.f2634>
 20. Hidayati NZ, Riyanto P. Hubungan Tingkat Stres dengan Derajat Keparahan Acne Vulgaris (Studi pada Mahasiswa Fakultas Kedokteran Universitas Diponegoro Angkatan 2012-2015). *DIPONEGORO Med J (JURNAL Kedokt DIPONEGORO)*. 2017;6(2):964–74.
 21. Regina Sutrisno A, Karmila Jusuf N, Budi Putra I. Correlation between Stress Scale and Severity of Acne Vulgaris. *Bali Med J*. 2020;9(1):376. Available from: <http://dx.doi.org/10.15562/bmj.v9i1.1749>
 22. Yutrishia L, Simanungkalit R, Jusuf N. Perbandingan Nilai pH Permukaan Kulit Wajah pada Kelompok Akne Vulgaris dan Kontrol. Universitas Sumatera Utara; 2016.
 23. Zhang J, Shen Y, Wang T, Zhou C, Wang X, Ding X, et al. Prevalence of Acne Vulgaris in Chinese Adolescents and Adults: A Community-based Study of 17,345 Subjects in Six Cities. *Acta Derm Venereol*. 2012;92(1):40–4. Available from: <http://dx.doi.org/10.2340/00015555-1164>
 24. El-Hamd MA, Nada EE-DA, Moustafa MA-K, Mahboob-Allah RA. Prevalence of acne vulgaris and its impact of the quality of life among secondary school-aged adolescents in Sohag Province, Upper Egypt. *J Cosmet Dermatol*. 2017;16(3):370–3. Available from: <http://dx.doi.org/10.1111/jocd.12328>
 25. A. Farage Miranda. Gender Differences in Skin Aging and the Changing Profile of the Sex Hormones with Age. *J Steroids Horm Sci*. 2012;03(02). Available from: <http://dx.doi.org/10.4172/2157-7536.1000109>
 26. See J-A, Goh CL, Hayashi N, Suh DH, Casintahan FA. Optimizing the use of topical retinoids in Asian acne patients. *J Dermatol*. 2018;04/03. 2018;45(5):522–8. Available from: <https://pubmed.ncbi.nlm.nih.gov/29611225>
 27. Kmiec ML, Pajor A, Broniarczyk-Dyla G. Evaluation of biophysical skin parameters and assessment of hair growth in patients with acne treated with isotretinoin. *Postep dermatologii i Alergol*. 2013/12/18. 2013;30(6):343–9. Available from: <https://pubmed.ncbi.nlm.nih.gov/24493996>
 28. Inui S, Aoshima H, Nishiyama A, Itami S. Improvement of acne vulgaris by topical fullerene application: unique impact on skin care. *Nanomedicine Nanotechnology, Biol Med*. 2011;7(2):238–41. Available from: <http://dx.doi.org/10.1016/j.nano.2010.09.005>
 29. Kantikosum K, Chongpison Y, Chottawornsak N, Asawanonda P. The efficacy of glycolic acid, salicylic acid, gluconolactone, and licochalcone A combined with 0.1% adapalene vs adapalene monotherapy in mild-to-moderate acne vulgaris: a double-blinded within-person comparative study. *Clin Cosmet Investig Dermatol*. 2019;12:151–61. Available from: <https://pubmed.ncbi.nlm.nih.gov/30858720>
 30. Constantin M-M, Poenaru E, Poenaru C, Constantin T. Skin hydration assessment through modern non-invasive bioengineering technologies. *Maedica (Buchar)*. 2014;9(1):33.
 31. Waller I, Suter B, Hettwer S, Obermayer B, Banziger S. In-Vitro Corneometry and Tewametry - Setting up skin substitute models to evaluate cosmetic moisturising materials. *H&PC Today*. 2015;10(4):43–50.
 32. Shen X, Guo M, Yu H, Liu D, Lu Z, Lu Y. Propionibacterium acnes related anti-inflammation and skin hydration activities of madecassoside, a pentacyclic triterpene saponin from *Centella asiatica*. *Biosci Biotechnol Biochem*. 2019;83(3):561–8. Available from: <http://dx.doi.org/10.1080/09168451.2018.1547627>
 33. Prescott SL, Larcombe D-L, Logan AC, West C, Burks W, Caraballo L, et al. The skin microbiome: impact of modern environments on skin ecology, barrier integrity, and systemic immune programming. *World Allergy Organ J*. 2017;10(1):29. Available from: <https://pubmed.ncbi.nlm.nih.gov/28855974>
 34. Jordan L, Baldwin HE. Stratum Corneum Abnormalities and Disease-Affected Skin: Strategies for Successful Outcomes in Inflammatory Acne. *J drugs dermatology JDD*. 2016;15(10):1170–3.
 35. Zhou M, Xie H, Cheng L, Li J. Clinical characteristics and epidermal barrier function of papulopustular rosacea: A comparison study with acne vulgaris. *Pakistan J Med Sci*. 2016;32(6):1344–8. Available from: <https://pubmed.ncbi.nlm.nih.gov/28083023>
 36. Mukherjee S, Mitra R, Maitra A, Gupta S, Kumaran S, Chakraborty 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. Available from: <https://pubmed.ncbi.nlm.nih.gov/27786295>
 37. Lynde CW, Andriessen A, Barankin B, De Gannes G, Gulliver W, Haber R, et al. Moisturizers and ceramide-containing moisturizers may offer concomitant therapy with benefits. *J Clin Aesthet Dermatol*. 2014;7(3):18.
 38. Turan N, Kapicioglu Y, Sarac G. The Effect of Skin Sebum, pH, and Moisture on Demodex Infestation in Acne Vulgaris and Rosacea Patients. *Turkish J Parasitol*. 2017;41(3):143–7. Available from: <http://dx.doi.org/10.5152/tpd.2017.5068>
 39. Aktaş Karabay E, Aksu Çerman A. Demodex folliculorum infestations in common facial dermatoses: acne vulgaris, rosacea, seborrheic dermatitis. *An Bras Dermatol*. 2020/02/12. 2020;95(2):187–93. Available from: <https://pubmed.ncbi.nlm.nih.gov/32113677>
 40. Isoda K, Seki T, Inoue Y, Umeda K, Nishizaka T, Tanabe H, et al. Efficacy of the combined use of a facial cleanser and moisturizers for the care of mild acne patients with sensitive skin. *J Dermatol*. 2014;42(2):181–8. Available from: <http://dx.doi.org/10.1111/1346-8138.12720>

