

Sleep Disturbances and Acne: A Comprehensive Review

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ABSTRACT **Introduction:** Acne, a common inflammatory skin disorder, is influenced by factors like hormones, age, and stress. Sleep also affects acne, as poor sleep quality can exacerbate skin issues.

Objective: This review aimed to explore the relationship between acne and sleep quality, examining the mechanisms, extent, and implications of this connection.

Methods: A systematic review of 18 studies was conducted to assess the link. Studies were retrieved from PubMed using predefined search criteria and evaluated for relevance.

Results: The findings indicate a bidirectional relationship between acne and sleep. Acne is associated with poor sleep quality, insomnia, and increased stress, while sleep deprivation exacerbates acne through hormonal imbalances, inflammation, and immune dysregulation.

Conclusion: There is a complex, bidirectional link between acne and sleep, requiring further research. Standardized metrics and behavioral interventions such as cognitive-behavioral therapy for insomnia could improve acne and sleep outcomes.

Introduction

Acne vulgaris is a common inflammatory skin disorder that occurs when hair follicles become clogged with sebum and dead skin cells, leading to outbreaks of lesions, including

comedones, inflammatory papules, and pustules. Factors that may increase the risk of developing acne include hormonal alterations, age, medications, and family history, while diet, stress, pressure, and environmental irritants can exacerbate the condition [1].

Given the role of factors like hormonal alterations, age, medications, and family history in skin health, it is crucial to recognize sleep as another critical component in maintaining skin integrity. Sleep is a period during which the skin undergoes a process of repair and regeneration, which preserves its elasticity and firmness. The impact of poor sleep quality on skin health is evident in increased signs of intrinsic aging, compromised skin barrier function, and reduced satisfaction with appearance [2]. This underscores the importance of understanding the connection between sleep disorders and skin conditions, making it an emerging area of research with significant implications for dermatological patient care.

Objectives

This review surveyed the existing evidence on the intricate relationship between acne and sleep quality to better understand the mechanisms, extent, and implications of this connection.

Materials and Methods

Data Sources and Eligibility Criteria

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines [3] (Table S1), a systematic search was conducted in August 2024 of the PubMed database using the following search phrase: (sleep OR sleep quality) AND (acne OR acne vulgaris). Two researchers independently screened titles and abstracts based on the selection criteria. Full-text articles were then retrieved and assessed

for inclusion, with reasons for exclusion documented. The inclusion criteria for this review included both clinical studies and reviews, with no publication date restrictions. Studies were excluded if they were not published in English, did not directly address acne in relation to sleep, or lacked sufficient data for analysis.

Data Extraction and Analysis

The information extracted from each of the included studies consisted of the study characteristics (authors, year, study design), population characteristics (sample size), measures of acne (severity), measures of sleep quality (e.g., Pittsburgh Sleep Quality Index [PSQI], self-reported sleep quality), and key findings on the relationship between acne and sleep quality.

Results

Characteristics of Included Studies

Figure 1 illustrates the study selection process. Of the 149 articles reviewed, 18 studies met the inclusion criteria: three reviews, two cohort studies, two case-control studies, nine cross-sectional studies, and two letters to the editor (Table 1). Collectively, these studies reported on over 4,498 patients with acne, excluding one study that did not specify the total number of acne patients.

Impact of Acne on Sleep

Acne is strongly associated with poor sleep and mood disturbances, including depression and anxiety [4,5]. A case-control study involving 81 acne patients found that they

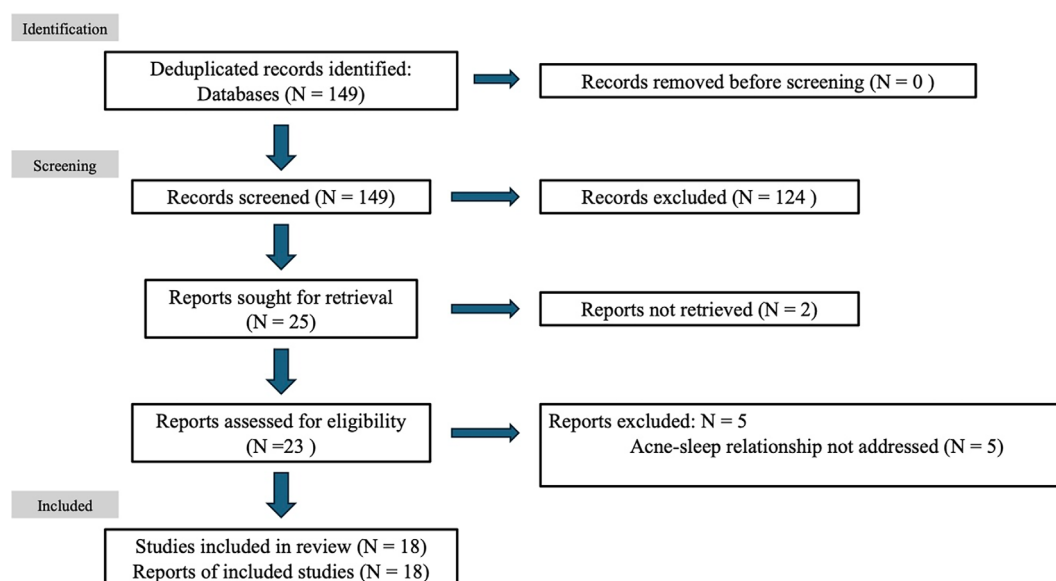


Figure 1. Flow Diagram of Study Selection.

Table 1. Study Characteristics.

Authors [Year]	Sample size	Study design	Sleep measures	Dermatologic measures	Key findings
Zhu J <i>et al.</i> (2023)	157 (81 acne, 76 control)	Case-control	PSQI; STAI; MEQ; ESS	IGA	Acne is highly associated with poor sleep and mood.
Pärna E, Aluoja A, Kingo K. (2015)	80 (40 acne, 40 control)	Cross-sectional	EST-Q	DLQI; RAND-36 (for health-related QoL)	Insomnia is significant among acne patients.
Arakaki FH <i>et al.</i> (2020)	NA	Letter to editor	NA	NA	Sleep loss may worsen acne; acne-related stress disrupts sleep.
Misery L <i>et al.</i> (2015)	1,375	Case-control	Self-reported questionnaire	CADI	Acne was linked to sleep issues and morning fatigue.
Suh DH <i>et al.</i> (2011)	657	Cross-sectional	Self-reported questionnaire	Self-reported questionnaire	Stress and limited sleep trigger and aggravate acne.
Wisuthsarewong W <i>et al.</i> (2020)	330	Cross-sectional	Self-reported questionnaire	Dermatologist-rated acne severity	Inadequate sleep and stress worsen acne.
Schrom KP <i>et al.</i> (2019)	40	Cohort	PSQI; sleep journal	GAGS; DLQI	Acne is correlated with worse QoL and depression.
Dashti HS <i>et al.</i> (2021)	16,509 (979 acne, 15,530 control)	Cross-sectional	Self-reported questionnaire	ICD-9 and ICD-10 codes	Sleep debt is strongly associated with acne.
Lu F <i>et al.</i> (2019)	384	Cross-sectional	Global PSQI scores	Self-reported questionnaire	Acne was more prevalent among poor sleepers.
Güler D, Soyulu S, Güler HA. (2023)	151	Cross-sectional	ISI; MEQ	GAGS; VAS; AQLS	Insomnia is correlated with QoL in acne patients.
Khormi G <i>et al.</i> (2024)	1,427	Cross-sectional	Self-reported sleep duration	Self-reported acne severity	Stress and sleep contribute to acne development.
Hua H <i>et al.</i> (2024)	83	Cohort	PSQI	ECCA scale	Sleep quality affects CO ₂ laser efficacy for acne scars.
Albuquerque RG <i>et al.</i> (2014)	NA	Review	NA	NA	Sleep distress may worsen acne.
Passeron T <i>et al.</i> (2021)	NA	Review	NA	NA	Sleep deprivation increases stress-related hormones.
Jusuf NK, Putra IB, Sutrisno AR. (2021)	60 (30 acne, 30 control)	Cross-sectional	Holmes-Rahe stress scale questionnaire	Serum substance P level	Sleep habit changes cause stress in acne patients, linked to increased substance P.
Xerfan EMS <i>et al.</i> (2021)	NA	Letter to editor	NA	NA	Poor sleep may trigger acne development.
Bilgiç Ö, Bilgiç A, Altinyazar HC. (2016)	85	Letter to editor	PSQI	Sebumeter® (SM815)	Sebum promotes acne but also has protective effects.
Yang J <i>et al.</i> (2020)	NA	Review	PSQI	TEWL	Poor sleep quality can negatively impact acne.

Abbreviations: Pittsburgh Sleep Quality Index (PSQI); State-Trait Anxiety Inventory (STAI); Morningness and Eveningness Questionnaire (MEQ); Epworth Sleepiness Scale (ESS); Investigator's Global Assessment (IGA); Emotional State Questionnaire (EST-Q); Dermatology Life Quality Index (DLQI); Research and Development (RAND); Not Applicable (NA); Cardiff Acne Disability Index (CADI); Global Acne Grading Scale (GAGS); Quality of life (QoL); International Classification of Diseases (ICD); Insomnia Severity Index (ISI); Visual Analogue Scale (VAS); Acne Quality of Life Scale (AQLS); échelle d'évaluation clinique des cicatrices d'acné (ECCA); Carbon dioxide (CO₂); Transepidermal water loss (TEWL)

scored higher on the Pittsburgh Sleep Quality Index (PSQI) and State-Trait Anxiety Inventory than did control patients, indicating poorer sleep quality and elevated anxiety levels [4]. Acne severity, evaluated with the Investigator's Global Assessment, was associated with sleep quality ($\beta=0.33$), depression ($\beta=0.66$), and anxiety (State: $\beta=1.73$; Trait: $\beta=1.21$) [4]. Those with acne often exhibit elevated levels of stress and emotional distress, mainly manifesting as insomnia and general anxiety. The stress and anxiety triggered by acne negatively impacts sleep quality [6]. Individuals with acne are more likely to experience difficulties falling asleep. In a survey of 1,375 individuals with acne, fatigue upon waking was strongly associated with the presence of acne (65.4% vs. 58.4%) [7].

Impact of Sleep on Acne

Sleep quality has a significant impact on acne severity and overall skin health. Poor sleep quality can exacerbate acne, as highlighted by one cross-sectional study, which identified psychological stress (82% of acne patients) and lack of sleep (75.2% of acne patients) as primary triggers or aggravating factors.⁸ Furthermore, a cross-sectional study involving 330 acne patients revealed that 65% of respondents felt inadequate sleep worsened their acne and believed it significantly impacted their quality of life [9]. When controlling for individuals' perception of quality of life and depressive symptoms, it was found that subjective sleep quality worsened as the objective acne severity score, measured by the Global Acne Grading System (GAGS), increased, and vice versa [9]. This finding aligns with several studies that demonstrate a strong positive correlation between acne severity and poor sleep quality [7,10-12].

Specifically, associations have been found between acne and various aspects of sleep quality, such as sleep debt [11] and fatigue upon waking, even when adjusting for age ($P<0.0001$) [7]. Additionally, stressed patients tend to experience more fatigue upon waking and are more prone to developing acne [7]. One cross-sectional study also reported a significantly positive correlation between the Insomnia Severity Index (ISI) and Acne Quality of Life Scale (ALQS) scores, indicating that insomnia symptoms are prevalent among acne patients and constitute a significant source of distress [13]. Similarly, sleep disorder symptoms were found to be a significant form of distress for these patients [5].

Both stress and poor sleep quality contribute to acne through disrupted hormonal balance and immune function [14]. These factors increase inflammation and a higher likelihood of acne flare-ups. Additionally, insufficient sleep can reduce the effectiveness of acne treatments, resulting in less favorable outcomes. For example, one study found a negative correlation between Pittsburgh Sleep Quality Index (PSQI) scores and the postoperative effectiveness of fractional CO₂

laser treatment for facial atrophic acne scars ($r=-0.5130$, $P<0.05$) [15].

Physiological Mechanisms

Poor sleep significantly affects acne pathogenesis, disrupting endocrine regulation and skin homeostasis and contributing to acne development. Sleep deprivation is associated with dysregulation of the hypothalamus-pituitary-adrenal (HPA) and neuroendocrine axes (NNA). It may act as a stressor, leading to elevated stress-related hormones such as cortisol [16], increased production of proinflammatory cytokines [16], and higher levels of substance P [17,18], a neuropeptide involved in transmitting pain signals and modulating inflammatory responses in the skin. One cross-sectional study conducted on 30 acne patients demonstrated a significantly positive correlation between stress and serum substance P level in acne patients with moderate strength ($r=0.446$; $P=0.014$) [19].

These physiological changes have been observed to exacerbate acne by promoting inflammation and sebum production [16,17,19]. Insufficient sleep has been linked to facial sebum dysregulation, which may lead to acne development [19]. Excess sebum contributes to acne by clogging pores, promoting bacterial growth, and triggering inflammation. However, the results of one study of 85 females with acne showed that good sleep quality was associated with elevated sebum levels, measured using a Sebumeter® over the T-zone, as sebum also has some protective and antimicrobial effects over the body ($P=0.007$) [20]. Additionally, sleep disturbance (PSQI >5 , sleep duration ≤ 5 hours) increases transepidermal water loss (TEWL) [21], impairs skin barrier recovery [16], and weakens the skin's defenses against external stimuli, further exacerbating the effects of both stress and sleep deprivation [21].

Discussion

The general trend of the literature suggests a bidirectional relationship between acne and sleep that involves a complex interaction between physiological and psychological mechanisms. Poor sleep exacerbates acne through various physiological mechanisms, such as hormonal imbalances and increased inflammation, and impacts emotional well-being and skin health.

Similarly, prior research found that dermatology patients are more subjectively sleep-disturbed, primarily due to skin-related issues [22]. More specifically, one study revealed that patients with inflammatory skin conditions report significantly more fatigue and have an increased risk of developing insomnia compared to patients with noninflammatory skin disorders [23]. Moreover, previous studies have demonstrated a link between sleep and other dermatological

conditions, including atopic dermatitis [24,25], chronic spontaneous urticaria [26,27], psoriasis [24,28,29], and rosacea [30].

Sleep and the immune system are interconnected in a feedback loop. While sleep is believed to play a role in regulating immune memory formation, the activity of the immune system influences sleep parameters such as latency, efficiency, and architecture [31]. Previous research has shown that inadequate sleep can stimulate inflammatory responses, increasing secretion of pro-inflammatory cytokines (such as TNF and IL-6) and excessive cortisol production [30,32].

While the evidence suggests a reciprocal relationship between acne and sleep quality, additional studies are necessary to clarify the underlying mechanisms involved for a more comprehensive understanding of the acne-sleep connection. Further investigation is also required to determine the effectiveness of behavioral interventions such as cognitive-behavioral therapy for insomnia (CBT-I) for patients with moderate-to-severe acne with sleep disturbances. Previous research has found CBT effective for other skin conditions such as atopic dermatitis [33] and psoriasis [34]. Therefore, these interventions should also be evaluated for their efficacy in acne patients, as they may improve both sleep quality and acne outcomes, offering new therapeutic approaches.

Limitations

The limitations of this review include data heterogeneity across studies, which may affect the consistency of the results. This discrepancy may be due to several factors, including variations in study design, differences in the populations studied, and the various tools and scales used to measure sleep quality and acne severity, making comparisons difficult. When comparing results across studies, the lack of uniform outcome measures may lead to conflicting or inconclusive findings. Nonetheless, the review offers valuable insights into the relationship between acne and sleep, proposing potential physiological mechanisms involved.

Conclusion

This review highlights the complex relationship between acne and sleep, potentially exacerbating each condition. Despite existing research, significant gaps still need to be filled in our understanding, particularly regarding the causal mechanisms and long-term impact of this interplay. Addressing these gaps through longitudinal studies, standardized metrics, and targeted interventions like cognitive-behavioral therapy could pave the way for more effective, personalized treatment strategies. Research in these areas could improve

sleep quality and acne outcomes, thereby enhancing the overall quality of life for affected individuals.

References

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):945-73.e33. DOI:10.1016/j.jaad.2015.12.037. PMID: 26897386.
2. Oyetakin-White P, Suggs A, Koo B, et al. Does poor sleep quality affect skin ageing?. *Clin Exp Dermatol*. 2015;40(1):17-22. DOI:10.1111/ced.12455. PMID: 25266053.
3. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med*. 2018;169(7):467-473. DOI:10.7326/M18-0850. PMID: 30178033.
4. Zhu J, Peng K, Zhang Y, Bai X, Zhong C, Ye J, Lu M. Sleep quality, circadian preferences, and mood among patients with acne vulgaris: a case-control study. *Sleep Breath*. 2023 Oct;27(5):1997-2003. DOI: 10.1007/s11325-023-02777-5. Epub 2023 Jan 18. PMID: 36650359.
5. Pärna E, Aluoja A, Kingo K. Quality of life and emotional state in chronic skin disease. *Acta Derm Venereol*. 2015 Mar;95(3):312-6. DOI: 10.2340/00015555-1920. PMID: 24978135.
6. Arakaki FH, Xerfan EMS, Tufik S, Andersen ML. Acne in men due to protein supplementation: how sleep could be related? *Sleep Med*. 2020 Nov;75:7. DOI: 10.1016/j.sleep.2020.06.007. Epub 2020 Jun 11. PMID: 32841913.
7. Misery L, Wolkenstein P, Amici JM, et al. Consequences of acne on stress, fatigue, sleep disorders and sexual activity: a population-based study. *Acta Derm Venereol*. 2015 Apr;95(4):485-8. DOI: 10.2340/00015555-1998. PMID: 25365961.
8. Suh DH, Kim BY, Min SU, et al. A multicenter epidemiological study of acne vulgaris in Korea. *Int J Dermatol*. 2011 Jun;50(6):673-81. DOI: 10.1111/j.1365-4632.2010.04726.x. PMID: 21595660.
9. Wisuthsarewong W, Nitiyaron R, Kanchanapenkul D, Arunkajohnsak S, Limphoka P, Boonchai W. Acne beliefs, treatment-seeking behaviors, information media usage, and impact on daily living activities of Thai acne patients. *J Cosmet Dermatol*. 2020 May;19(5):1191-1195. DOI: 10.1111/jocd.13132. Epub 2019 Sep 9. PMID: 31498553.
10. Schrom KP, Ahsanuddin S, Baechtold M, Tripathi R, Ramser A, Baron E. Acne Severity and Sleep Quality in Adults. *Clocks Sleep*. 2019 Dec 6;1(4):510-516. DOI: 10.3390/clockssleep1040039. PMID: 33089183; PMCID: PMC7445853.
11. Dashti HS, Cade BE, Stuttaite G, Saxena R, Redline S, Karlson EW. Sleep health, diseases, and pain syndromes: findings from an electronic health record biobank. *Sleep*. 2021 Mar 12;44(3):zsa189. DOI: 10.1093/sleep/zsa189. PMID: 32954408; PMCID: PMC7953212.
12. Lu F, Suggs A, Ezaldein HH, et al. The Effect of Shift Work and Poor Sleep on Self-Reported Skin Conditions: A Survey of Call Center Agents in the Philippines. *Clocks Sleep*. 2019 May 17;1(2):273-279. DOI: 10.3390/clockssleep1020023. PMID: 33089169; PMCID: PMC7445847.
13. Güler D, Soyulu S, Güler HA. The relationship of quality of life and acne severity with chronotype and insomnia in patients with acne vulgaris. *Arch Dermatol Res*. 2023 Aug;315(6):1689-1695.

- DOI: 10.1007/s00403-023-02569-7. Epub 2023 Feb 21. PMID: 36809407.
14. Khormi G, Aldubayyan N, Hakami M, Daghriri S, Aqeel S. Impact of Lifestyle and Dietary Habits on the Prevalence of Acne Vulgaris: A Cross-Sectional Study From Saudi Arabia. *Cureus*. 2024 Mar 29;16(3):e57200. DOI: 10.7759/cureus.57200. PMID: 38681286; PMCID: PMC11056197.
 15. Hua H, Li M, Zhai X, et al. Sleep quality correlates with effectiveness of ultrapulse fractional CO₂ laser in the treatment of facial atrophic acne scars. *J Dermatol*. 2024 Aug;51(8):1120-1124. DOI: 10.1111/1346-8138.17112. Epub 2024 Jan 31. PMID: 38292007.
 16. Albuquerque RG, Rocha MA, Bagatin E, Tufik S, Andersen ML. Could adult female acne be associated with modern life? *Arch Dermatol Res*. 2014 Oct;306(8):683-8. DOI: 10.1007/s00403-014-1482-6. Epub 2014 Jun 21. PMID: 24952024.
 17. Passeron T, Zouboulis CC, Tan J, et al. Adult skin acute stress responses to short-term environmental and internal aggression from exposome factors. *J Eur Acad Dermatol Venereol*. 2021 Oct;35(10):1963-1975. DOI: 10.1111/jdv.17432. Epub 2021 Jun 24. PMID: 34077579; PMCID: PMC8519049.
 18. Jusuf NK, Putra IB, Sutrisno AR. Correlation Between Stress Scale and Serum Substance P Level in Acne Vulgaris. *Int J Gen Med*. 2021 Mar 1;14:681-686. DOI: 10.2147/IJGM.S294509. PMID: 33688239; PMCID: PMC7935437.
 19. Xerfan EMS, Facina AS, Andersen ML, Tufik S, Tomimori J. Acne flare-up due to mask wearing: A current pandemic scenario and its relationship with sleep. *Skin Res Technol*. 2021 Sep;27(5):1002-1003. DOI: 10.1111/srt.13048. Epub 2021 May 17. PMID: 33998704; PMCID: PMC8242399.
 20. Bilgiç Ö, Bilgiç A, Altinyazar HC. Relationship between sleep quality and facial sebum levels in women with acne vulgaris. *Indian J Dermatol Venereol Leprol*. 2016 May-Jun;82(3):313-4. DOI: 10.4103/0378-6323.174408. PMID: 27088937.
 21. Yang J, Yang H, Xu A, He L. A Review of Advancement on Influencing Factors of Acne: An Emphasis on Environment Characteristics. *Front Public Health*. 2020 Sep 17;8:450. DOI: 10.3389/fpubh.2020.00450. PMID: 33042936; PMCID: PMC7527424.
 22. Tamschick R, Navarini A, Strobel W, Müller S. Insomnia and other sleep disorders in dermatology patients: A questionnaire-based study with 634 patients. *Clin Dermatol*. 2021;39(6):996-1004. DOI:10.1016/j.clindermatol.2021.09.001. PMID: 34920837.
 23. Mostaghimi L, Hetzel S. Insomnia and other sleep complaints in inflammatory versus noninflammatory skin disorders: An observational case-control study. *Int J Dermatol*. 2019;58(8):976-981. DOI:10.1111/ijd.14488. PMID: 31168791.
 24. Walia HK, Mehra R. Overview of Common Sleep Disorders and Intersection with Dermatologic Conditions. *Int J Mol Sci*. 2016;17(5):654. Published 2016 Apr 30. DOI:10.3390/ijms17050654. PMID: 27144559.
 25. Jeon C, Yan D, Nakamura M, et al. Frequency and Management of Sleep Disturbance in Adults with Atopic Dermatitis: A Systematic Review. *Dermatol Ther (Heidelb)*. 2017;7(3):349-364. DOI:10.1007/s13555-017-0192-3. PMID: 28707054.
 26. Can A, Coskun R, Karabacak DE, et al. Common but neglected problem in chronic spontaneous urticaria: Sleep disturbance. *Allergy Asthma Proc*. 2023;44(3):179-185. DOI:10.2500/aap.2023.44.230011. PMID: 37160750.
 27. Sánchez-Díaz M, Rodríguez-Pozo JÁ, Latorre-Fuentes JM, Salazar-Nievas MC, Alejandro ML, Arias-Santiago S. Sleep Quality as a Predictor of Quality-of-Life and Emotional Status Impairment in Patients with Chronic Spontaneous Urticaria: A Cross-Sectional Study. *Int J Environ Res Public Health*. 2023;20(4):3508. Published 2023 Feb 16. DOI:10.3390/ijerph20043508. PMID: 36834203.
 28. Henry AL, Kyle SD, Bhandari S, Chisholm A, Griffiths CE, Bundy C. Measurement, Classification and Evaluation of Sleep Disturbance in Psoriasis: A Systematic Review. *PLoS One*. 2016;11(6):e0157843. Published 2016 Jun 21. DOI:10.1371/journal.pone.0157843. PMID: 27327082.
 29. Guo M, Su J, Zheng S, Chen B. Sleep in psoriasis: A meta-analysis. *J Psychosom Res*. 2024;176:111543. DOI:10.1016/j.jpsychores.2023.111543. PMID: 37956475.
 30. Wang Z, Xie H, Gong Y, et al. Relationship between rosacea and sleep. *J Dermatol*. 2020;47(6):592-600. DOI:10.1111/1346-8138.15339. PMID: 32291809.
 31. Myers B, Reddy V, Chan S, Thibodeaux Q, Brownstone N, Bhutani T. Sleep, Immunological Memory, and Inflammatory Skin Disease. *Dermatology*. 2021;237(6):1035-1038. DOI:10.1159/000510082. PMID: 32966973.
 32. Arif MK, Zee PC, Paller AS, Crowley SJ, Roenneberg T, Fishbein AB. Severe atopic dermatitis, sleep disturbance, and low light exposure. *Sleep*. 2024;47(1):zsad276. DOI:10.1093/sleep/zsad276. PMID: 37935914.
 33. Hedman-Lagerlöf E, Bergman A, Lindefors N, Bradley M. Exposure-based cognitive behavior therapy for atopic dermatitis: an open trial. *Cogn Behav Ther*. 2019;48(4):300-310. DOI:10.1080/16506073.2018.1504320. PMID: 30192705.
 34. Xiao Y, Zhang X, Luo D, et al. The efficacy of psychological interventions on psoriasis treatment: a systematic review and meta-analysis of randomized controlled trials. *Psychol Res Behav Manag*. 2019;12:97-106. Published 2019 Feb 7. DOI:10.2147/PRBM.S195181. PMID: 30799963.