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ORIGINAL ARTICLE

The correlation between academic stress, sleep quality, and acne severity: a longitudinal cohort study

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ABSTRACT

Objective: To evaluate the relationship between acne severity, sleep quality, and stress levels in undergraduate students and to create a predictive model for acne severity.

Methods: This longitudinal cohort study was conducted at Isra University Hyderabad on 150 acne-prone undergraduate students. The Perceived Stress Scale, Sleep Quality Scale, and Comprehensive Acne Severity Scale were used for data collection during the non-examination and examination periods, respectively.

Results: The mean age of the study participants was 20.08±1.42 years. A statistically significant rise was observed in perceived stress ($p<0.01$), sleep quality ($p<0.01$), and acne severity ($p<0.01$) during the examination period. A statistically significant association of acne severity was observed with male gender (X2-9.51, $p<0.05$). A significant positive correlation of acne severity was observed with perceived stress ($r=0.95$, $P<0.01$) and sleep quality ($r=0.95$, $P<0.01$). Among predictors of acne severity, age ($p<0.05$), stress score ($p<0.05$), and sleep score ($p<0.05$) were found to be significant predictors whereas BMI was found to be non-significant ($p>0.05$).

Conclusion: Acne is correlated with higher stress levels and poor sleep quality. Young age, high stress, and poor sleep are significant predictors of acne severity. This makes acne breakouts common among students, particularly during periods of examinations.

Keywords: Acne Vulgaris (MeSH); Perceived Stress Scale (Non-MeSH); Sleep Quality (MeSH); Mental Health (MeSH); Students (MeSH); Students, Medical (MeSH); Patient Acuity (MeSH); Stress, Physiological (MeSH).

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INTRODUCTION

Acne Vulgaris (AV), often referred to as acne, zits, or pimples, is a common and long-lasting skin condition caused by oil and dead skin cells clogging the pores on the skin.[1,2] Acne is the most prevalent skin-related issue dermatologists treat, affecting over 85% of people at some point in their life.[3] Acne, which affects 9.4% of the world's population, is estimated to be the eighth most common ailment globally.[4] Comedones, both open comedones (blackheads) and closed comedones (whiteheads), are frequently seen in acne patients. They may also show up with pustules, which are inflamed lesions packed with pus, papules, which are elevated lesions less than 1 cm, and, in severe cases, nodules and cysts.[5] Additionally, people with acne may exhibit signs like hyperpigmentation, erythema, and scarring.[6] Although acne is not fatal, it can have a substantial psychological impact. Symptoms include the emergence of a type D personality and social phobia disorder (SAD), increased anxiety, tension, sadness, and, in severe cases, suicidal ideation.[7] This phenomenon is known as "the butterfly effect," in which a seemingly isolated skin disease has an impact on a person's mental health, relationships with others, and general quality of life.[8,9]

Although the precise etiology of acne remains unknown, it is generally accepted to be a multifactorial condition triggered by hormone changes, nutrition, pollutants, lack of sleep, familial susceptibility, sebum production, and the usage of cosmetic products.[10,11]

Among these factors, stress emerges as a pivotal contributor to acne development.[12,13] There is evidence that indicates that the relationship between stress and acne is attributed to the hypothalamic-pituitary-adrenal (HPA) axis, which has a direct impact on sebaceous gland activity.[14,15] The sebaceous glands in the skin have receptors for the hormone corticotropin-releasing (CRH).[16] Stress-related elevations in CRH can, in turn, cause an overproduction of sebum and blockage of pilosebaceous gland ducts. Another theory suggests that CRH causes keratinocytes to produce more cytokines (IL-6 and IL-11), which promote inflammation and aid in the onset of acne.[17]

Low quality sleep is yet another contributing factor in the development of acne.[18] This is attributed to the fact that hormones from the HPA axis, including melatonin, are involved in regulating the sleep-wake cycle, and their malfunction can cause sleep disturbances.

Consequently, insufficient sleep affects the HPA axis, causing it to become hyperactive.[19] There is evidence to support the complex bidirectional interaction between stress and sleep, which can result in a vicious cycle.[20,21] This explains why acne sufferers often report outbreaks during stressful situations and periods of poor sleep, including final exams.[22]

The objective of the current study was

to evaluate the relationship between acne severity, sleep quality, and stress levels in undergraduate students. The current study also sought to create a predictive model for acne severity by integrating various variables, with the ultimate goal of obtaining a more thorough comprehension of the elements that influence acne severity.

METHODS

This longitudinal cohort study was approved by the Isra University Ethical Review Board (ERB letter no: U/RR-10-IRC-23/N/2022/815) and was conducted at Isra University Hyderabad, from April 2023 to October 2023. A non-probability purposive sampling technique was employed and 150 participants were selected. An open-source calculator, OpenEpi (version 3) was used to calculate the sample size, keeping anticipated frequency at 14.7%, confidence level at 95%, and margin of error at 5%. The study participants were selected from Isra University Hyderabad and Mehran University of Engineering and Technology (MUET), jamshoro to have a fair representation of the diversity of the student body. Informed consent was obtained with the guarantee that the information would only be used for scientific purposes and that the anonymity of the participants would be maintained. A total of 175 students were invited to participate, and 150 students completed both rounds of the survey, resulting in a response rate of approximately 85%. Participants who failed to respond to either of the rounds were excluded from the analysis. To maximize response rates, reminders were sent via email/text, and participants were assured of their anonymity.

The inclusion criteria were both medical and non-medical undergraduate students between 17-25 years of age, with acne, and who gave consent for study participation. Whereas students <17 and >25 years, postgraduates, participants with no prior history of acne, individuals with a history of dermatological conditions other than acne, individuals with ongoing treatment for any mental health condition that may impact stress or sleep quality, and those who did not provide informed written consent were excluded from the study.

Data was collected utilizing an online web-based questionnaire through google forms. Data collection was conducted in two rounds; the first round took place more than a month before exams (off-exams period), while the second round took place a week before exams (exams period). A self-designed structured questionnaire was used encompassing demographic details such as age, gender, area of residence, accommodation, and field of study.

The Perceived Stress Scale (PSS-10) and Sleep Quality Scale (SQS) were used to measure participants' perceived stress and sleep quality respectively. PSS-10 is a cross-culturally validated questionnaire, designed to gauge how stressful a person perceives certain situations in their life. It is a 10-item, 5-point Likert scale, reflecting the extent of perceived stress; with scores ranging from 0-40 with higher scores indicating a higher perceived stress level.

SQS is a 28 item self-report scale that helps evaluate six distinct domains of sleep quality. Respondents rate how frequently they engage in specific sleep behaviours on a 4-point Likert scale. Total scores can range from 0-84, with higher scores indicating more severe sleep issues.

The acne severity of the study participants was assessed using the Comprehensive Acne Severity Scale (CASS). This validated acne-grading scale, which strongly correlates with the Leeds Acne Grading Scale (LAGS), includes a scale for grading and counting lesions on the face, chest, and back; with acne severity being classified into five grades from 0-5 (clear to very severe).

Qualitative variables were expressed as frequencies/percentages while quantitative variables were expressed as Mean±SD. Using SPSS (version 22) and GraphPad Prism (version 8), the statistical analysis of the difference between various quantitative and quantitative variables across groups was evaluated by Chi-square test and Student's t-test respectively. Pearson's bivariate correlation analysis was used to evaluate the relationships between stress, sleep quality, and acne. Multiple regression analysis was done to investigate the factors influencing acne severity. A p-value of ≤0.05 was considered statistically significant.

RESULTS

A vast majority of the study participants were females (118; 78.67%) while 32 (21.33%) were males. The mean age of the study participants was 20.08±1.42 years with an age range of 17-24 years. The majority of the participants belonged to urban areas (81.33%) and were day-scholars (68%). Most of the participants had a normal BMI (61.33%). Nearly half of the participants belonged to a medical field of study (49.34%) while the other half belonged to a non-medical field of study (50.66%) (Table1).

The mean scores of perceived stress, sleep quality, and acne severity among the study participants during the non-examination period were found to be 22.22±3.95, 32.16±9.37, and 1.22±1.13 respectively. During the examination period, mean scores of perceived stress, sleep quality, and acne severity among the study participants were found to be 23.94±4.04, 37.57±9.43, and 1.88±1.31 respectively. A statistically significant rise was observed across all three variables during the examination period; perceived stress ($p < 0.01$), sleep quality ($p < 0.01$), and acne severity ($p < 0.01$) [Figure 1].

A statistically significant positive correlation was observed between perceived stress scores and sleep quality scores ($r=0.98$, $P<0.01$), as well as perceived stress scores and acne severity scores ($r=0.95$, $P<0.01$). Similarly, a statistically significant positive correlation was also observed between sleep quality scores and acne severity scores ($r=0.95$, $P<0.01$). These findings suggest that a rise in perceived stress levels and sleep quality scores (i.e. poor sleep quality) tend to increase acne severity [Figure 2].

A statistically significant association of acne severity was observed with gender (X 2-9.51, $p<0.05$), with higher acne severity scores being observed in males as compared with females, during the

Table I: Demographic summary of acne patients (n=150)

Variables		Frequency	Percentage
Age group (years)	<18	06	4.00
	18-20	94	62.66
	21-22	42	28.00
	<22	8	5.33
Gender	Male	32	21.33
	Female	118	78.67
Residence	Urban	122	81.33
	Rular	28	18.66
Accommodation	Day Scholar	102	68.00
	Hostelite	48	32.00
Field of study	Medical	74	49.34
	Non-medical	76	50.66
Body Mass Index (kg/m^2)	Underweight	32	21.33
	Normal	92	61.33
	Overweight	20	13.33
	Obese	6	4.00

Table II: Regression analysis results for Comprehensive Acne Severity Scale (CASS) score (n=150)

Variables	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-3.6426	1.378622	-2.6422	0.009*	-6.36739	-0.91781
Age	-0.13272	0.04985	-2.66238	0.009*	-0.23212	-0.03332
Body Mass Index	0.037556	0.024106	1.557934	0.121	-0.01009	0.085201
Stress score	0.121226	0.020925	5.793368	0.001*	0.079869	0.162583
Sleep score	0.025847	0.010323	2.503715	0.013*	0.005443	0.046251

* Statistically significant (p-value <0.05) using Multivariate Regression Analysis.

examination period. However, there was no statistically significant association found between acne severity and residence (X 2-2.79, p>0.05), field of study (X 2-1.39, p>0.05), and accommodation (X 2-2.51, p>0.05), during the examination period.

(Table II) Shows that age (p<0.05), stress score (p<0.05), and sleep score (p<0.05) are significant predictors of acne severity in our study. Age is negatively associated with acne severity i.e. an increase in age is associated with a decrease in the estimated acne severity score. While higher stress and sleep scores are positively associated with increased acne severity. The association of BMI with acne severity was found to be statistically non-significant (p>0.05).

DISCUSSION

This study sought to explore the association of acne with various demographic variables as well as to assess its correlation with stress and sleep quality. Although often disregarded as a cosmetic nuisance due to its ubiquitous nature and limited physical effect on everyday life, dermatologists have acknowledged acne as not being a killer, but being able to scar people both literally and psychologically.[24]

In the current study, 150 undergraduates from various academic fields reported significantly elevated levels of stress (p<0.05), poorer sleep quality (p<0.05), and an increase in the severity of acne (p<0.05) during exam season. This supports the findings of Alotaibi AD, et al., who found that examination periods are linked to poor sleep quality and higher levels of stress among students in a study done at the College of Medicine at Imam Muhammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia.[25] In addition, Alotaibi AD, et al., also observed poor sleep quality was significantly associated with the level of stress in students (P<0.05), which is also parallel with the findings of the current study.[25]

In this study, the prevalence of acne was 78.67% and 21.33% among females and males, respectively. Jaber RM, et al., reported acne to be prevalent in 70.9% of females in a study conducted in Jordan, whereas Huei LT, et al., in a study conducted in Malaysia, reported acne to be present in 65.8% of females as opposed to 34.2% of males, which is in accordance with the findings of the current study.[26,27] This higher incidence of acne in females can possibly be due to the relatively earlier onset of puberty in females as well as hormonal irregularities caused by menstrual cycle, oral contraceptives, and pregnancy.[5,28] Dréno B, et al., reported the prevalence of acne was considerably higher in individuals living in urban areas, which is also consistent with the findings of the current study.[29] This can be attributed to exposure to ambient air pollutants, from vehicles and industries, in urban regions that trigger an oxidation response in the skin. This leads to a depletion of the cutaneous antioxidants such as vitamin E and subsequent keratinocyte hyperproliferation and release of inflammatory cytokine, ultimately triggering the onset or worsening of acne.[30]

Numerous studies have also reported a higher prevalence of acne among patients with increased BMI.[29,31] In

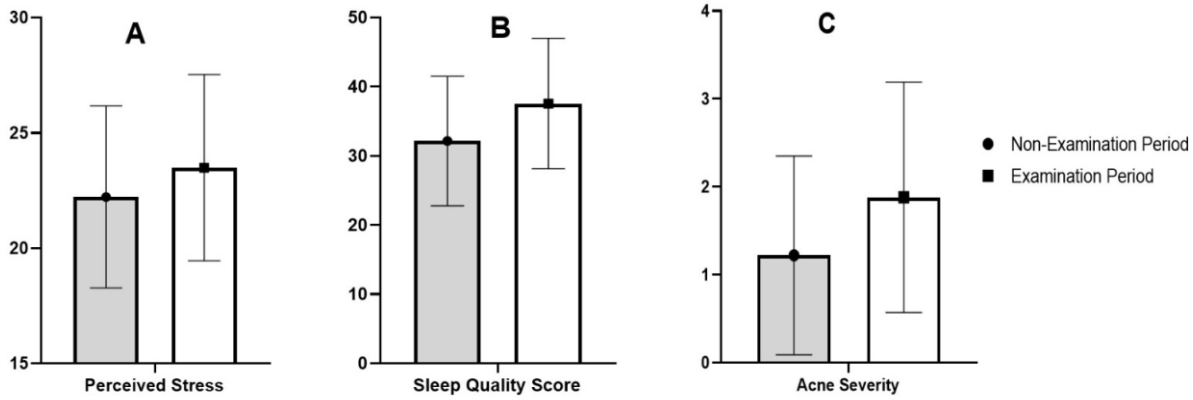

Figure 1: **A**-Perceived Stress Scale score. **B**-Sleep Quality Score. **C**-Comprehensive Acne Severity Scale score.

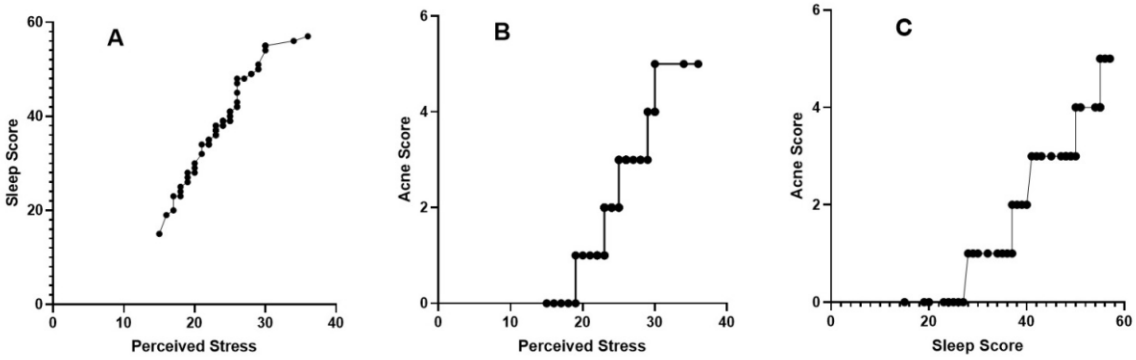

Figure 2: **A**-Correlation between Perceived Stress score and Sleep score; **B**-Correlation between Perceived Stress score and Acne score; **C**-Correlation between Sleep score and Acne score.

contrast, however, most of the acne patients in the current study had a normal BMI. This could be due to the fact that we did not take into account any potential confounders such as dietary habits, daily screen time exposure, smoking, family history, etc. Chaudhary S, et al., in a study conducted in Lahore, reported 56.12% of the acne patients in their study of having a normal BMI, which is consistent with the findings of the current study.[32]

In the current study, a significant rise in acne severity was observed among participants during the examination period with a positive correlation with the levels of perceived stress. This is similar to the findings of Basfar AS, et al., who observed a significant positive correlation between perceived stress score and acne severity among students in a study conducted in Taif University, Saudi Arabia.[33] Aziz F, et al., also observed stress to be positively correlated with acne severity among students in a study conducted at King Khalid University, Saudi Arabia; whereas, in a study conducted at King Abdul Aziz University, Jeddah, Ibrahim NK, et al., reported students were 6.5 times more likely to suffer from acne when exposed to stress.[22,34] However, during stress, the severity of acne was found to be greater among males as compared to their female counterparts in the current study. This can be a result of sample bias, as the number of male participants was significantly smaller than their female counterparts. This can also be attributed to the difference in the tendency to seek medical care among genders; as the acne severity rises, females are more inclined to seek medical attention.[26] Zhu J, et al., reported acne to be highly associated with poor sleep quality which is also in line with the findings of the current study.[35] Poor sleep quality disrupts the skin's barrier causing increased transepidermal water loss and cutaneous dehydration. This dryness of skin along with a compromised epidermal barrier weakens the skin's defense system, leading to a flare-up of skin diseases, especially acne.[10] In contrast, however, Chaudhary S, et al., and Schrom KP, et al., reported no significant correlation between sleep and acne severity.[18,32]

In addition to increased stress and poor sleep quality, age was also found to be a significant predictor of acne severity in the present study. Acne was found to be highest in the 18-20 age group whereas the incidence decreased with the progression of age. In a study conducted on 10,521 participants from France, Spain, Italy, Poland, Czech and Slovak Republics, and Belgium, Wolkenstein P, et al., reported the prevalence of acne was highest in the <18 years age group and decreased

with the increase in age.[36] Furthermore, in a multivariate model, Wolkenstein P, et al., observed the probability of having acne decreased with the progression of age, which is consistent with the findings of the current study.[36]

Although acne is not a life-threatening issue, it does have serious psychological implications including depression, anxiety, negative self-image, social withdrawal, and impaired social behavior that adversely affect the well-being of those suffering from it.[37] High stress, poor sleep, and young age make students the prime target of acne and its plethora of complications, necessitating the need for comprehensive treatment and support programs that address not only the dermatological but also the psychological aspects of the disease.

The current study provides valuable insight regarding the potential predictors of acne among students. However, several limitations must be acknowledged. Response bias may have influenced the findings due to the reliance on self-reported metrics for stress, sleep quality, and acne severity. The non-probability purposive sampling technique and the use of online questionnaires may have introduced selection bias, potentially limiting the generalizability of the results. Additionally, the study did not account for potential confounding factors such as smoking, greasy or oily skin, menstrual irregularities, consumption of sugary or greasy food, dairy products, genetic predisposition, improper cosmetics application, prolonged cellphone use, hot temperatures, and exposure to sunlight, which could affect the observed relationships between stress, sleep, and acne.

CONCLUSION

Acne is correlated with higher stress levels and poor sleep quality. Young age, high stress, and poor sleep are significant predictors of acne severity. This makes acne breakouts common among students, particularly during periods of examinations. This highlights the need for comprehensive treatment and support programs in higher education institutes that address not only the dermatological but also the psychological aspects of the disease.

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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

KAM: Conception and study design, acquisition, analysis and interpretation of data, drafting the manuscript, approval of the final version to be published

HA, UH & UMS: Acquisition of data, drafting the manuscript, approval of the final version to be published

MFP & UR: Analysis and interpretation of data, critical review, approval of the final version to be published

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

Authors declared no conflict of interest, whether financial or otherwise, that could influence the integrity, objectivity, or validity of their research work.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request

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