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(Research/Review) Article

Analysis of Risk Factors for Acne Vulgaris in Grade X–XI Students at Rantepao Christian High School, North Toraja Regency

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Abstract: Background: Acne vulgaris is a chronic inflammatory disease of the pilosebaceous unit that often occurs in adolescents. Various factors have been reported to be associated with the occurrence and characteristics of acne, including genetic factors, dietary patterns, psychological stress, skin care habits, and cosmetic use. However, the relationship between these factors and acne severity varies across populations. Objective: This study aimed to analyze factors associated with acne severity in grades X–XI students at Rantepao Christian High School, North Toraja Regency. Methods: This was an observational analytical study with a cross-sectional design. The sample consisted of 100 grades X–XI students selected using a total sampling technique. Data were collected using a structured questionnaire that included information on family history of acne, consumption patterns of sweet foods and dairy products, stress levels, facial skin care habits, and cosmetic use. Stress levels were measured using the Perceived Stress Scale (PSS). Acne severity was assessed based on the number of acne lesions and categorized into several levels of severity through physical examination of the patients. Data analysis was performed using ordinal regression to evaluate the relationship between study variables and acne severity. Results: The distribution of acne severity showed that most respondents experienced mild acne (53%), followed by moderate acne (40%), and severe acne (7%). Bivariate analysis showed that consumption patterns of sweet foods and dairy products were associated with acne severity (p=0.002) and cosmetic use showed a significant association in the initial analysis (p=0.040). In multivariate ordinal regression analysis, consumption patterns of sweet foods and dairy products remained associated with acne severity (p=0.019), and stress levels showed an association in the multivariate model (p=0.027). Family history, facial skin care habits, and cosmetic use did not show a significant association after adjustment for variables in the analysis model. Conclusion: Several factors measured in this study showed an association with acne severity in the adolescent population studied.

Keywords: Acne Vulgaris; Acne Severity; Adolescents; Food Consumption Patterns; Stress.

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1. Introduction

Acne vulgaris is a chronic inflammatory disease of the pilosebaceous unit characterized by the formation of comedones, papules, pustules, nodules, or cysts on the skin. This condition often appears during adolescence and is one of the most common dermatological problems in this age group. The high prevalence of acne in the adolescent population indicates that this condition is a common health problem during puberty. In addition to clinical manifestations on the skin, acne can also be associated with impacts on quality of life and psychosocial aspects, including self-perception and emotional state in individuals who experience acne lesions.[1,2]

Pathophysiologically, acne involves several key mechanisms in the pilosebaceous unit: increased sebum production, follicular hyperkeratinization, colonization of microorganisms in the follicles, and an inflammatory response in the skin tissue. The interaction between these mechanisms plays a role in the formation of acne lesions of varying severity. Various factors

have also been reported to be associated with the occurrence and characteristics of acne, including genetics, dietary patterns, psychological stress, skin care habits, and cosmetic use.[1,3,4]

Several studies have shown that lifestyle and psychological factors may be associated with acne characteristics. Consumption patterns of foods with a high glycemic load and consumption of dairy products have been reported to be associated with the occurrence and characteristics of acne in various adolescent and young adult populations.[5–7] Furthermore, psychological stress has also been reported to be associated with neuroendocrine activity and inflammatory responses in the skin, which are associated with the development of acne lesions.[8,9] These findings suggest that lifestyle and psychological factors may be associated with variations in acne characteristics.

However, research on factors associated with acne shows variation across populations. Some studies report an association between diet and stress with the occurrence or characteristics of acne, while others show inconsistent results for genetic factors, skin care habits, or cosmetic use.[1,3,4,10] These varying findings suggest that acne risk factors may differ across populations and environments.

Research on risk factors associated with acne severity in adolescents is still limited to specific populations. Therefore, it is important to evaluate the association of multiple risk factors simultaneously in adolescents. This study aimed to analyze factors associated with acne severity in grades [10,11] at Rantepao Christian High School, North Toraja Regency.

2. Materials and Method

This is an analytical observational study with a cross-sectional design. The aim was to evaluate the relationship between several risk factors and acne severity in an adolescent population. This approach was used to assess the relationship between exposure variables and acne severity at a single observation point within the study population. The study was conducted at Rantepao Christian High School, North Toraja Regency. Data were collected from 10th-11th grade students residing at the school during the study period.

The study population was all 10th-11th grade students at Rantepao Christian High School. The study sample consisted of 100 respondents who met the study criteria. The sampling technique used a total sampling approach, selecting students who met the inclusion criteria at the time of the study. The inclusion criteria were 10th-11th grade students who agreed to participate in the study, completed the questionnaire, and were willing to undergo a physical examination. Respondents who did not complete all components of the questionnaire or did not meet the study criteria were excluded from the analysis.

The dependent variable in this study was acne severity. The independent variables analyzed included family history of acne, consumption of sweet foods and dairy products, stress levels, facial skin care habits, and cosmetic use. Data collection was conducted using a structured questionnaire completed by respondents. The questionnaire included information on respondent characteristics, family history of acne, consumption of sweet foods and dairy products, facial skin care habits, cosmetic use, and stress levels.

Respondents' stress levels were assessed using the Perceived Stress Scale (PSS). Acne severity was assessed based on the number of observed acne lesions, which were then categorized into specific severity levels according to the criteria used in this study. Data analysis was performed using statistical software. Descriptive analysis was used to describe respondent characteristics and the distribution of study variables. Bivariate analysis was conducted using ordinal regression to evaluate the relationship between each independent variable and acne severity. Furthermore, multivariate analysis was conducted using ordinal regression to assess the relationship between the independent variables simultaneously and acne severity. The fit of the ordinal regression model was evaluated using goodness-of-fit tests, including the Pearson and Deviance tests, as well as the model's pseudo-R^2 value.

This study was conducted with due regard for the principle of respondent data confidentiality. Respondent participation was voluntary, and all respondents were given an explanation of the purpose of the study before completing the questionnaire. The data obtained in this study will be used solely for research purposes.

3. Results and Discussion

Respondent Characteristics and Distribution of Acne Severity

A total of 100 students in grades 10–11 participated in the analysis. The mean age of respondents was 15.58 ± 0.65 years, with a range of 15–17 years. Most respondents were female (73.7%), while 26.3% were male. The distribution of acne severity showed that 53.0%

of respondents experienced mild acne, 40.0% moderate acne, and 7.0% severe acne. The mean number of comedones was 28.23 ± 25.61 (range 2–110), the number of papules/pustules/nodules was 13.94 ± 15.13 (range 0–75), and the number of cysts was 0.24 ± 0.91 (range 0–6). The mean total number of lesions was 42.23 ± 37.67, with a range of 2–162.

Most respondents had a family history of acne (65.0%). Frequent consumption of sweet foods and dairy products was reported by 82.0% of respondents. Facial skin care was categorized as poor in 22.0%, fair in 49.0%, and good in 29.0%. Sixty-nine percent of respondents reported using cosmetics. Based on the Perceived Stress Scale (PSS), 39.0% experienced mild stress, 57.0% moderate stress, and 4.0% severe stress. These findings illustrate the characteristics of the study population, as well as the distribution of acne severity and primary exposure factors among the 10th–11th grade students studied.

Table 1. Demographic Characteristics of Respondents (n=100)

Variable	n	%
Age (Year)		
15	51	51,0
16	40	40,0
17	9	9,0
Gender		
Male	26	26,3
Female	73	73,7

Table 2. Distribution of Acne Severity (n=100)

Severity	n	%
Mild	53	53,0
Moderate	40	40,0
Severe	7	7,0

Table 3. Number of Acne Lesions

Variables	Mean ± SD	Minimum	Maximum
Number of comedones	28,23 ± 25,61	2	110
Papules/pustules/nodules	13,94 ± 15,13	0	75
Cysts	0,24 ± 0,91	0	6
Total lesions	42,23 ± 37,67	2	162

Table 4. Distribution of Exposure Factors (n=100)

Variables	n	%
Family History		
None	35	35,0
Yes	65	65,0
Sweet & Dairy Diet		
Rarely	18	18,0
Often	82	82,0
Facial Skin Care		
Poor	22	22,0
Fairly Good	49	49,0

Good	29	29,0
Cosmetic Use		
None	31	31,0
Yes	69	69,0
Stress Level (PSS)		
Mild Stress	39	39,0
Moderate Stress	57	57,0
Severe Stress	4	4,0

Bivariate Analysis of Risk Factors and Acne Severity

Bivariate analysis was conducted using ordinal regression to assess the relationship between each risk factor and acne severity. The results showed that a diet high in sweet foods and dairy products was significantly associated with acne severity (p=0.002). Furthermore, cosmetic use also showed a statistically significant association with acne severity (p=0.040). Conversely, family history (p=0.407) and facial skin care (p=0.677) did not show a statistically significant association with acne severity. Stress levels, based on the Perceived Stress Scale (PSS) score, showed a trend toward an association with acne severity, but did not reach statistical significance (p=0.056).

Table 5. Bivariate Analysis of Risk Factors on Acne Severity

Variables	Model Chi-Square	df	p-value	Description
Family history	0,686	1	0,407	Not significant
Sweet and dairy diet	9,230	1	0,002	Significant
Facial skin care	0,781	2	0,677	Not significant
Cosmetic use	4,228	1	0,040	Significant
Stress level (PSS)	5,756	2	0,056	Not significant

Multivariate Ordinal Regression Analysis

Multivariate ordinal regression analysis was conducted to assess the simultaneous association between several risk factors and acne severity. The model test results showed that the overall regression model was significant (χ^2=17.540; df=7; p=0.014). Nagelkerke's pseudo-R^2 value of 0.194 indicated that the variables in the model partially explained the variation in acne severity.

In the multivariate model, a diet high in sweets and dairy products remained significantly associated with acne severity (p=0.019; β coefficient=-1.622; 95% CI: -2.982 to -0.262). Furthermore, stress level categories based on the PSS also showed an association with acne severity in the multivariate model, with a β coefficient=-2.510 (p=0.027; 95% CI: -4.741 to -0.279). In contrast, family history (p=0.883), facial skin care (p=0.726 and p=0.430), and cosmetic use (p=0.133) did not show a significant association after adjustment in the multivariate model. This finding indicates that some variables that showed an association in the bivariate analysis did not retain statistical significance after being controlled for by other variables in the model.

Table 6. Results of Multivariate Ordinal Regression on Acne Severity

Variables	Koefisien (β)	Std. Error	p-value	95% CI
Stress Level (PSS)				
PSS Category 1	**-2,510**	**1,138**	**0,027**	**-4,741 – -0,279**
PSS Category 2	**-2,053**	**1,088**	**0,059**	**-4,185 – 0,080**

Family History	**0,069**	**0,467**	**0,883**	**-0,846 – 0,983**
Sweet and Dairy Diet	**-1,622**	**0,694**	**0,019**	**-2,982 – -0,262**
Facial Skin Care				
Poor	**0,227**	**0,646**	**0,726**	**-1,040 – 1,494**
Fairly Good	**0,398**	**0,504**	**0,430**	**-0,590 – 1,386**
Cosmetic Use	**-0,751**	**0,500**	**0,133**	**-1,731 – 0,229**

Table 7. Ordinal Regression Model Suitability Test

Parameter	Value
Chi-square model	17,540
df	7
p-value	0,014
Pseudo R^2 (Cox & Snell)	0,161
Pseudo R^2 (Nagelkerke)	0,194
Pseudo R^2 (McFadden)	0,099

Evaluation of Model Fit and Estimate Stability

The fit of the ordinal regression model was evaluated using the Pearson goodness-of-fit and Deviance tests. The analysis showed a Pearson chi-square value of 50.491 (df=63; p=0.872) and a Deviance chi-square value of 46.002 (df=63; p=0.947). A p-value greater than 0.05 in both tests indicates no significant difference between the observed values and the values predicted by the model. During the modeling process, a warning was issued regarding the presence of cells with a frequency of zero in the combination of predictor and outcome variable categories. In the multivariate model, 50 cells (46.3%) had a frequency of zero. This condition indicates limited data distribution across several combinations of variable categories.

These findings indicate that the ordinal regression model generally has a good fit based on the goodness-of-fit test results. However, the presence of cells with a frequency of zero indicates limited estimate stability for some variable categories in the model.

Table 8. Goodness-of-Fit Test of Ordinal Regression Model

Uji Goodness-of-Fit	Chi-Square	df	p-value
Pearson	50,491	63	0,872
Deviance	46,002	63	0,947

Table 9. Model Stability Evaluation

Evaluation Parameters	Value
Total cell combinations	108
Cells with zero frequency	50
Percentage of empty cells	46,3%

Model interpretation	The model shows a good fit based on the goodness-of-fit test, but there are empty cells that can affect the stability of the estimates.

Discussion

The Relationship between Sweet Food and Dairy Product Consumption Patterns and Acne Severity

The analysis in this study shows that sweet food and dairy product consumption patterns are significantly associated with acne severity. In bivariate analysis, this variable showed a statistically significant association (p=0.002), and this association remained after adjustment in a multivariate ordinal regression model (p=0.019). These findings suggest that sweet food and dairy product consumption patterns are associated with variations in acne severity in the study population.

This relationship can be understood through pathophysiological mechanisms involving hormonal and metabolic changes in the pilosebaceous unit. Consumption of foods with a high glycemic load, including sweet foods, can trigger an increase in postprandial blood glucose levels, which stimulates insulin secretion. This hyperinsulinemic condition can reduce insulin-like growth factor binding protein-3 (IGFBP-3) levels, thereby increasing free insulin-like growth factor-1 (IGF-1) levels, which plays a role in increasing sebaceous gland activity and keratinocyte proliferation in the pilosebaceous unit.[5,6,11–13]

Furthermore, dairy products also contain bioactive components that can strengthen the insulin and IGF-1 pathways. Whey protein and natural hormones in milk are known to enhance insulin signaling through the phosphoinositide-3-kinase/Akt pathway, which plays a role in regulating sebocyte activity. Activation of this pathway can influence androgen receptor activity and comedogenesis in the pilosebaceous unit, which is subsequently associated with increased sebum production and acne lesion formation.[5,6,11,13]

Elevated IGF-1 levels have also been reported to be associated with activation of the mTORC1 pathway, which can promote sebocyte lipogenesis and an inflammatory response in the pilosebaceous follicle. The combination of consuming sweet foods with dairy products can maintain a prolonged state of low-grade hyperinsulinemia, which in some studies has been associated with increased severity of acne.[5,7,13–16]

The Relationship Between Stress Levels and Acne Severity

The results of this study indicate that stress levels are associated with acne severity in a multivariate ordinal regression model. In a model that included multiple variables simultaneously, certain stress categories showed a significant association with acne severity (p=0.027). This finding suggests that the stress levels measured in this study are associated with variations in acne severity in the studied population.

The relationship between stress and acne severity can be explained through neuroendocrine interactions that affect pilosebaceous unit function. Psychological stress is known to activate the hypothalamic-pituitary-adrenal (HPA) axis, which triggers the release of corticotropin-releasing hormone (CRH). Activation of this pathway can influence sebaceous gland activity by increasing lipogenesis and androgen metabolism in sebocytes, contributing to increased sebum production and acne lesion formation.[8,17]

Furthermore, stress also involves the sympatho-adrenal medullary system, which increases the release of catecholamines, including norepinephrine. These neuroendocrine mediators can interact with sebocytes and keratinocytes through specific receptors on the pilosebaceous unit, thus contributing to the inflammatory response in the skin. Studies have shown that increased levels of these mediators, including normetanephrine in hair follicles, are found in acne lesions in individuals with higher levels of anxiety[8,9]

Inflammatory processes also play a role in the relationship between stress and acne severity. Activation of the HPA axis and neuroendocrine mediators can increase the production of proinflammatory cytokines such as IL-1, IL-6, and TNF-α in skin tissue, contributing to the inflammatory environment in the pilosebaceous unit. This condition can exacerbate the inflammatory processes involved in acne lesion formation and is associated with increased disease severity.[2,8,9,18]

Factors That Did Not Show a Significant Relationship with Acne Severity

In this study, several variables did not show a significant relationship with acne severity after adjustment in a multivariate ordinal regression model. These variables included family history, facial skin care habits, and cosmetic use. Although these factors are often associated

with the occurrence or development of acne, the analysis in this study showed that these variables did not show a statistically significant relationship with acne severity in the studied population.

Family history is one factor biologically associated with a predisposition to acne. Previous research has shown that acne has a strong genetic component, with high heritability estimates and greater concordance rates in monozygotic twins compared to dizygotic twins. Genetic variations affecting inflammatory pathways and sebaceous gland function have also been reported to be associated with acne occurrence and severity in various populations. 1,3,19–21 However, in this study, family history did not show a significant relationship with acne severity after other variables were included in the analysis model.

Facial skin care habits also did not show a significant relationship with acne severity in the multivariate model. Theoretically, skin hygiene practices can influence the condition of the pilosebaceous unit by influencing the accumulation of sebum, dead skin cells, and microorganisms on the skin surface. Optimal facial cleansing practices have been reported to help reduce the accumulation of these components and potentially influence the development of acne lesions.[22,23] However, in this study, respondents' reported facial skin care habits did not show a significant association with variations in acne severity.

Cosmetic use also did not show a significant association with acne severity after adjusting for other variables in a multivariate model. Several studies have shown that certain cosmetic products may have comedogenic potential, which may influence the formation of microcomedoes and acne lesions through an occlusive effect on the pilosebaceous follicle.[4,10,24–26] However, the analysis in this study did not show a significant association between cosmetic use and acne severity in the study population.

Comparison of Research Results with Previous Studies

The results of this study indicate that consumption patterns of sweet foods and dairy products are associated with acne severity, and this association remained after adjustment in a multivariate regression model. This finding aligns with several previous studies that reported an association between consumption patterns of foods with a high glycemic load and consumption of dairy products with both the incidence and severity of acne. Studies assessing the relationship between dairy product consumption and acne in adolescent and young adult populations have shown that consumption of milk and dairy products is associated with an increased incidence of acne.[5–7,15]

Furthermore, the association between stress levels and acne severity found in the multivariate model in this study also aligns with findings from previous research. Several studies have reported that psychological stress is associated with increased neuroendocrine activity and inflammation, which are associated with the development of acne lesions in individuals with higher stress levels.[2,8,9,18]

Conversely, several variables in this study did not show a significant association with acne severity after adjustment in the analysis model. Family history, facial skin care habits, and cosmetic use did not show a statistically significant association in this study. These findings are in contrast to several studies that have reported a link between genetic factors, skin care practices, or the use of certain cosmetics and the occurrence or severity of acne.[1,3,4,10]

Implications of Research Findings for Understanding Acne Risk Factors in Adolescents

The findings of this study indicate that several factors studied have varying associations with acne severity in the adolescent population. Consumption patterns of sweet foods and dairy products, as well as stress levels, showed associations with acne severity in the statistical analysis. In contrast, other variables such as family history, facial skin care habits, and cosmetic use did not show significant associations after adjustments were made in the analysis model.

The association between consumption patterns of sweet foods and dairy products and acne severity in this study aligns with the literature reporting that consumption patterns of foods with a high glycemic load and dairy products have been linked to the occurrence and severity of acne in adolescents and young adults.[5–7,15] These findings suggest that certain food consumption patterns may be associated with variations in acne severity in the adolescent age group studied.

Furthermore, the association between stress levels and acne severity found in the multivariate model aligns with previous research reporting that psychological stress may be associated with changes in neuroendocrine activity and inflammation associated with the development of acne lesions.[2,8,9,18] These findings suggest that psychological factors may be associated with variations in acne severity in the adolescent population studied.

At the same time, the results of this study indicate that several factors frequently associated with acne in the literature did not show a significant association in the analysis. Family history, facial skin care habits, and cosmetic use did not show a significant association with acne severity after adjustment for variables in a multivariate model. Several previous studies have reported an association between genetic factors, skin care practices, and cosmetic use with the occurrence or characteristics of acne, but these associations were not evident in statistical analyses in this study population.[1,3,4,10]

Strengths of the Study

This study has several methodological aspects that can be considered strengths in evaluating factors associated with acne severity in the adolescent population. First, the study involved a relatively sufficient number of respondents for statistical analysis, allowing for evaluation of the relationship between several exposure variables and acne severity in the study population.

Second, the study used an ordinal regression analysis approach to evaluate the relationship between exposure variables and acne severity. This analytical approach allows for the simultaneous assessment of relationships between several variables by considering acne severity as an ordinal variable, thus providing a more comprehensive picture of the relationship between the studied factors and variations in acne severity.

Furthermore, the relatively homogeneous characteristics of the study population, namely 10th–11th grade students from a single educational institution, allow for the evaluation of risk factors within an age group of adolescents with relatively similar environmental backgrounds. This approach can help illustrate the pattern of relationships between the studied factors and acne severity in the adolescent population that is the focus of the study.

This study also evaluated several factors that have been reported in the literature to be related to acne, including dietary patterns, stress levels, family history, skincare habits, and cosmetic use. These factors have been discussed in various previous studies that assessed the relationship between lifestyle factors, genetic factors, and environmental factors with the development and characteristics of acne in adolescent and young adult populations.[1,5,6,8]

Research Limitations

This study has several limitations that should be considered when interpreting the results. First, the study used a cross-sectional design, so the associations found between the studied factors and acne severity reflect associations at a single point in time. This design does not allow for assessment of the temporal relationship between exposure and the development of acne severity.

Second, several variables in this study were obtained through respondent self-report using a questionnaire, including dietary patterns, stress levels, facial skin care habits, and cosmetic use. This approach allows for variation in respondent self-reporting, which could influence the measurement of the exposures studied. Variations in dietary patterns and other lifestyle factors have also been reported in various studies evaluating the relationship between diet, psychological factors, and acne in adolescent populations.[5,6,8]

Furthermore, the data distribution in the ordinal regression model in this study indicated several combinations of variable categories with low or unobserved frequencies. This condition may affect the stability of the estimates in the analytical model used. Although the ordinal regression model allows for the simultaneous evaluation of the relationship between several variables on acne severity, the distribution of data across multiple variable categories may affect the accuracy of the model's parameter estimates.

This study was also conducted in a population of adolescents within a single educational institution with relatively similar age and environmental characteristics. These specific population characteristics allow for evaluation of the factors studied in specific adolescent age groups, but may limit the variation in population characteristics observed in this study. The variety of genetic, environmental, and behavioral factors reported in the literature suggests that population characteristics may influence the pattern of risk factors associated with acne.[1,3]

Directions for Further Research

The results of this study indicate that several factors studied are associated with acne severity in adolescents, while others did not show a significant association in the analysis. Considering these findings, future research could consider a research design approach that allows for a more longitudinal evaluation of the relationship between exposure and acne development. This approach could provide a clearer picture of the dynamics of lifestyle factors, psychological factors, and changes in acne severity over a longer observation period.

Furthermore, further research could consider measuring exposure variables with a more detailed approach, particularly regarding dietary consumption patterns and psychological factors reported to be associated with acne in various previous studies. Variations in consumption patterns of foods with a high glycemic load and consumption of dairy products have been reported to be associated with the occurrence and characteristics of acne in various populations.[5–7,15] A more detailed approach to measuring dietary consumption patterns could help illustrate this relationship more specifically.

Future research could also consider a more in-depth evaluation of psychological factors related to acne. Several studies have reported that psychological stress is associated with neuroendocrine activity and inflammatory responses in the skin, which are linked to the development of acne lesions.[2,8,9,18] Research approaches that integrate the measurement of psychological factors with clinical evaluation of acne may provide a more comprehensive picture of this relationship.

In addition to lifestyle and psychological factors, further research could also consider a broader evaluation of genetic factors and individual characteristics that have been reported in the literature to be related to acne. Genetic variations affecting inflammatory pathways and pilosebaceous unit function have been reported to be associated with the occurrence and characteristics of acne in various populations.[1,3] Research approaches that integrate biological and behavioral factors may provide a broader understanding of variations in acne severity in the adolescent population.

5. Conclusion

This study evaluated the relationship between several risk factors and acne severity in grades 10–11 students at Rantepao Christian High School. The distribution of acne severity in the study population showed that most respondents experienced mild acne, followed by moderate acne and severe acne. The analysis results showed that consumption patterns of sweet foods and dairy products were associated with acne severity in the statistical analysis. In addition, stress levels also showed a relationship with acne severity in a multivariate ordinal regression model. In contrast, family history, facial skin care habits, and cosmetic use did not show a significant relationship with acne severity after variable adjustment in the analysis model.

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