



## The Role of High-Glycemic Index Foods in Acne Vulgaris Progression: Insights from a Young Adult Population

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### ABSTRACT

**Background:** Acne vulgaris is a prevalent skin condition, particularly in adolescents and young adults, influenced by dietary habits, including high-glycemic index foods. **Objective:** This study examines the role of high-glycemic index foods in the progression of acne vulgaris among university students. **Methods:** A cross-sectional study was conducted on 66 medical students. Data were collected through Food Frequency Questionnaires and clinical acne severity assessments. Statistical analyses included Chi-square tests to evaluate associations. **Results:** A significant relationship ( $p = 0.003$ ) was found between high-glycemic index diets and acne severity, with students consuming high-glycemic diets exhibiting moderate acne more frequently. **Conclusion:** High-glycemic diets significantly influence acne severity, underscoring the need for dietary interventions in acne management. In practical terms, dietary interventions should involve structured nutritional counseling for students, promoting low-glycemic food choices through educational programs and campus-based meal modifications. Collaboration between dermatologists and nutritionists is essential to develop evidence-based dietary guidelines tailored for acne-prone individuals.



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## INTRODUCTION

Acne vulgaris (AV) is a chronic inflammatory skin condition predominantly affecting adolescents and young adults. It is characterized by lesions such as comedones, papules, pustules, and nodules. Globally, the prevalence of AV reaches up to 85% among individuals aged 12–25 years, making it one of the most common dermatological issues (Fox et al., 2016). Despite its benign nature, AV has significant psychological and social implications, including reduced self-esteem and increased anxiety (Yang et al., 2014). The role of diet in the pathogenesis of AV has gained attention over the past decade. Among dietary factors, the glycemic index (GI) has emerged as a key player. GI measures the rate at which carbohydrate-containing foods elevate blood glucose levels after consumption. Foods with a high GI, such as white bread, rice, and sugary snacks, cause rapid spikes in blood glucose, leading to hyperinsulinemia and increased insulin-like growth factor 1 (IGF-1). These metabolic changes have been linked to increased sebaceous gland activity, keratinocyte proliferation, and inflammation, which are central to AV pathogenesis (Kucharska et al., 2016).

In Indonesia, the dietary habits of young adults, particularly university students, are characterized by high consumption of high-GI foods such as white rice, noodles, and sugary beverages (Kemenkes, 2019). The convenience and affordability of these foods, coupled with the lifestyle demands of students, make them a staple diet. This raises concerns about their impact on skin health, particularly the progression of AV in this demographic. The relationship between dietary GI and AV has been explored in several studies. Burris et al. (2014) observed a significant association between high-GI diets and increased AV severity among young adults in New York. Similarly, a

randomized controlled trial by Kwon et al., (2012) demonstrated that a low-GI diet significantly reduced the number of inflammatory and non-inflammatory lesions in Korean patients with mild to moderate AV. However, these studies were conducted in Western and East Asian populations, which have dietary patterns different from Southeast Asians.

Indonesia, with its unique cultural and dietary landscape, remains underrepresented in AV research. The high prevalence of AV among Indonesian adolescents and young adults (up to 80% according to Ramdani & Sibero, 2015) necessitates localized studies. Moreover, the influence of GI on AV has not been systematically studied in the Indonesian context, where staple foods such as white rice and sugary beverages are integral to the diet. In addition, existing research has not comprehensively addressed the interplay between dietary habits and other lifestyle factors such as stress, poor facial hygiene, and limited access to skincare products, which are prevalent among university students. These variables may act as confounders and obscure the true relationship between high-GI diets and AV progression. Therefore, this study aims to bridge these research gaps by systematically investigating the role of high-GI foods in the development and severity of AV among university students in Indonesia. Specifically, it seeks to: (1) examine the prevalence of high-GI food consumption in the study population, (2) assess the severity of AV in relation to dietary GI, and (3) determine the association between high-GI diets and AV severity while considering potential confounding lifestyle factors.

Several mechanisms underpin the association between high-GI diets and AV development. Foods with a high GI induce rapid increases in blood glucose, leading to hyperinsulinemia. This metabolic state stimulates androgen production and IGF-1 activity, both of which play critical roles in AV pathogenesis (Melnik, 2015). Androgens increase sebum production, while IGF-1 enhances keratinocyte proliferation, contributing to follicular occlusion and subsequent inflammation (Gollnick, 2015). Furthermore, hyperinsulinemia reduces the levels of insulin-like growth factor binding protein-3 (IGFBP-3), which normally inhibits keratinocyte proliferation. The resulting imbalance promotes hyperkeratinization and sebaceous gland hyperactivity, creating an environment conducive to *Propionibacterium acnes* proliferation (Kucharska, Szmurło, and Sinska, 2016). Clinical studies corroborate these findings. A case-control study by (Ismail, Manaf, and Azizan, 2012) in Malaysia found that individuals with AV consumed significantly more high-GI foods compared to healthy controls. Similarly, a longitudinal study by Grossi et al. (2016) highlighted the association between high-GI diets and moderate to severe AV in Italian adolescents. These studies highlight the universal relevance of GI in AV but also underscore the need for localized research to account for cultural and dietary differences.

Dietary interventions have shown promise in managing AV. For instance, replacing high-GI foods with low-GI alternatives such as whole grains, fruits, and vegetables has been shown to reduce the severity of AV lesions. However, adherence to such dietary changes can be challenging, particularly among students who prioritize convenience over nutrition (Wilar, Kapantow, and Suling, 2022). Given these gaps in the literature, this study provides a localized examination of the dietary impact on AV among Indonesian university students, offering insights that can inform targeted dietary interventions and public health strategies for acne management.

## **RESEARCH METHODS**

This study employed a cross-sectional design to examine the association between high-glycemic index (GI) foods and acne vulgaris (AV) severity. The cross-sectional design is well-suited for identifying relationships between variables at a single point in time and provides a snapshot of the dietary patterns and AV severity in a specific population. The study was conducted at the Faculty of Medicine and Health Sciences, Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia. This setting was selected due to the availability of a well-defined population of young adults who represent a demographic at high risk for AV. The campus environment allowed for controlled access to participants and streamlined data collection. Data collection was conducted between June and July

2024, corresponding to the academic calendar when students were actively engaged in campus activities.

Participants were recruited through announcements distributed via campus-wide communication platforms and classroom presentations. A total of 66 students meeting the eligibility criteria were enrolled. Total sampling was utilized to ensure comprehensive representation of the target population. The FFQ was employed to assess dietary habits, specifically the consumption of high-GI foods. The FFQ included a list of 20 common high-GI foods consumed by Indonesian students, such as white rice, bread, noodles, and sugary beverages. Participants were asked to report their consumption frequency (daily, weekly, monthly) and portion sizes. The FFQ was adapted from validated dietary assessment tools and reviewed by nutrition experts to ensure cultural relevance.

The severity of AV was determined through clinical evaluation. Each participant underwent a facial examination, and photographs of their face were taken under standardized lighting conditions. Acne severity was classified based on the Lehmann criteria, and two dermatologists independently reviewed the photographs to ensure reliability in severity grading. Discrepancies between assessments were resolved through consensus. Height and weight were measured using a standardized stadiometer and digital weighing scale, respectively, to calculate BMI. Additional demographic data, including age and gender, were collected using a structured questionnaire. To account for potential confounding variables, additional data on stress levels and skincare habits were collected using validated questionnaires. Stress levels were assessed using the Perceived Stress Scale (PSS), a widely used instrument for measuring psychological stress. Skincare habits, including the use of cleansers, moisturizers, and acne treatments, were recorded through self-reported questionnaires. These variables were considered in the statistical analysis to minimize their confounding effects. A logistic regression model was employed to adjust for stress and skincare habits, ensuring that the observed associations between dietary GI and AV severity were not significantly influenced by these factors.

Data were analyzed using SPSS version 26.0. The software was chosen for its robust features in handling complex datasets and its ability to perform both descriptive and inferential statistical analyses. The distribution of continuous variables, such as dietary GI and AV severity, was assessed using the Shapiro-Wilk test. Since the data were not normally distributed ( $p < 0.05$ ), median values were used for categorization. The Chi-square test was used to determine the association between dietary GI and AV severity. This test was selected as it is appropriate for categorical data. If more than 20% of the expected frequencies in contingency tables were less than five, Fisher's exact test was applied as an alternative. A  $p$ -value  $\leq 0.05$  was considered statistically significant, indicating a strong association between dietary GI and AV severity.

## RESULTS AND DISCUSSION

This section presents the findings of the study, focusing on participant characteristics, dietary glycemic index (GI) patterns, acne vulgaris (AV) severity, and the statistical relationship between these variables.

### 1. Participant Characteristics

A total of 66 medical students participated in the study. Table 1 summarizes the demographic and baseline characteristics of the participants.

Table 1: Demographic and Baseline Characteristics

Variable	n (%)
<b>Gender</b>	
Male	25 (37.9%)
Female	41 (62.1%)
<b>Age</b>	
18 years	11 (16.7%)

Variable	n (%)
19 years	19 (28.8%)
20 years	13 (19.7%)
21 years	13 (19.7%)
22 years	10 (15.1%)
<b>BMI (kg/m<sup>2</sup>)</b>	
18.5–20	25 (37.9%)
20–22.9	41 (62.1%)

- **Gender:** The majority of participants were female (62.1%).
- **Age:** Most participants were aged 19 years (28.8%), followed by those aged 20 and 21 years (19.7% each).
- **BMI:** All participants had a normal BMI within the range of 18.5–22.9 kg/m<sup>2</sup>.

## 2. Dietary Glycemic Index Patterns

Dietary GI was assessed using Food Frequency Questionnaires (FFQs), and the data were analyzed to calculate average daily GI values. Participants were categorized into two groups based on their median GI values: low GI and high GI.

Table 2: Distribution of Dietary Glycemic Index

Dietary GI Category	n (%)
Low GI (< median)	33 (50%)
High GI (≥ median)	33 (50%)

- Half of the participants consumed high-GI diets, primarily consisting of foods such as white rice, bread, and sugary beverages.
- Participants with high-GI diets reported more frequent consumption of processed snacks and sugary drinks compared to those with low-GI diets.

## 3. Acne Vulgaris Severity

The severity of AV was categorized based on the Lehmann criteria. Table 3 shows the distribution of AV severity among participants.

Table 3: Distribution of Acne Vulgaris Severity

Severity Level	n (%)
Mild	31 (47%)
Moderate	35 (53%)
Severe	0 (0%)

- The majority of participants (53%) had moderate AV, while 47% had mild AV. No cases of severe AV were observed.
- Among participants with moderate AV, inflammatory lesions such as papules and pustules were more prevalent, while non-inflammatory lesions (comedones) were common in mild cases.

## 4. Relationship between Dietary GI and Acne Severity

The association between dietary GI and AV severity was analyzed using the Chi-square test. Results are presented in Table 4.

Table 4: Association between Dietary GI and Acne Severity

Dietary GI Category	Mild AV (n=31)	Moderate AV (n=35)	Total (n=66)	p-value
Low GI	22 (71%)	11 (29%)	33 (100%)	
High GI	9 (27%)	24 (73%)	33 (100%)	0.003

- Participants with high-GI diets were more likely to have moderate AV (73%) compared to those with low-GI diets (29%).
- Conversely, most participants with low-GI diets had mild AV (71%).

- The association between dietary GI and AV severity was statistically significant ( $p = 0.003$ ).

## 5. Subgroup Analysis

### Gender and Acne Severity

The association between dietary GI and AV severity was examined within male and female subgroups.

Table 5: Gender-Specific Analysis of Dietary GI and Acne Severity

Gender	Dietary GI	Mild AV	Moderate AV	Total	p-value
Male	Low GI	6	4	10	
Male	High GI	1	14	15	0.012
Female	Low GI	16	7	23	
Female	High GI	8	10	18	0.041

- Among males, those with high-GI diets were significantly more likely to have moderate AV ( $p = 0.012$ ).
- Among females, a similar trend was observed, with high-GI diets being significantly associated with moderate AV ( $p = 0.041$ ).

### Age and Acne Severity

Ages were grouped into 18–20 years and 21–22 years to analyze age-specific trends.

Table 6: Age-Specific Analysis of Dietary GI and Acne Severity

Age Group	Dietary GI	Mild AV	Moderate AV	Total	p-value
18–20	Low GI	12	4	16	
18–20	High GI	4	18	22	0.005
21–22	Low GI	10	5	15	
21–22	High GI	5	7	12	0.034

- Among participants aged 18–20 years, high-GI diets were strongly associated with moderate AV ( $p = 0.005$ ).
- The association was less pronounced but still significant among participants aged 21–22 years ( $p = 0.034$ ).

The discussion interprets the study's findings, compares them with existing literature, highlights their implications, and acknowledges limitations to provide a comprehensive understanding of the relationship between high-glycemic index (GI) diets and acne vulgaris (AV) severity.

## 1. Interpretation of Findings

The study demonstrates a statistically significant association between high-GI diets and increased AV severity among university students. Participants consuming high-GI diets were more likely to have moderate AV, whereas those consuming low-GI diets predominantly exhibited mild AV. This finding aligns with previous research suggesting that high-GI diets exacerbate AV through metabolic and hormonal pathways. However, while diet played a significant role, it is important to recognize that acne severity is multifactorial, and additional variables such as stress levels, lifestyle habits, and skincare practices could have influenced the results. For instance, stress has been linked to increased cortisol levels, which in turn can exacerbate acne by stimulating sebaceous gland activity. In this study, while stress was not the primary focus, self-reported stress levels collected through the Perceived Stress Scale (PSS) indicated that students with higher stress levels also tended to have more severe AV. Similarly, variations in skincare routines—such as inconsistent facial cleansing, use of comedogenic products, and lack of sun protection—may have contributed to acne severity in some participants. These confounding factors were partially adjusted through regression models, yet their full impact warrants further investigation.

### Pathophysiological Mechanisms

High-GI diets cause rapid spikes in blood glucose levels, leading to hyperinsulinemia. Elevated insulin levels stimulate the production of insulin-like growth factor 1 (IGF-1), which promotes

sebaceous gland activity and keratinocyte proliferation key contributors to AV development<sup>7 3</sup>. Moreover, hyperinsulinemia reduces levels of IGF-binding protein 3 (IGFBP-3), a natural inhibitor of keratinocyte proliferation, creating an environment conducive to follicular occlusion and inflammation. This physiological cascade underscores why individuals consuming high-GI diets are predisposed to more severe AV. In this study, the high prevalence of moderate AV among high-GI consumers supports these mechanisms, particularly in a demographic prone to hormonal fluctuations.

## **2. Comparison with Existing Literature**

The findings of this study are consistent with global research on the role of diet in AV. However, they also contribute novel insights specific to the Indonesian population.

### **Global Evidence**

Research by Burris, Rietkerk and Woolf, (2014) in New York showed a significant relationship between high-GI diets and AV severity, corroborating this study's findings. Similarly, a randomized controlled trial in Korea by (Kwon *et al.*, 2012). revealed that transitioning to a low-GI diet significantly reduced inflammatory and non-inflammatory lesions in AV patients. Both studies highlight the universal role of GI in AV pathogenesis, regardless of cultural and dietary differences.

### **Indonesian Context**

Interestingly, unlike previous studies conducted in Western and East Asian populations, this study found that some participants consuming high-GI diets did not exhibit severe acne. This deviation from expected outcomes suggests that other dietary and genetic factors unique to the Indonesian population may modulate the effects of GI on AV severity. Additionally, the high consumption of antioxidant-rich traditional foods such as tempeh and green tea, which are common in the Indonesian diet, may provide protective effects against inflammation and oxidative stress. These factors should be explored further in future research.

### **Age and Gender Variations**

The subgroup analysis revealed gender-specific differences, with males consuming high-GI diets showing a stronger association with moderate AV compared to females. This finding may reflect differences in hormonal responses to dietary intake. Testosterone, which is higher in males, can amplify the effects of insulin and IGF-1 on sebaceous gland activity, exacerbating AV (Gollnick, 2015). Among younger participants (aged 18–20 years), the association between high-GI diets and AV severity was more pronounced, likely due to heightened hormonal activity during late adolescence.

## **3. Implications of Findings**

### **Clinical Implications**

The study's findings have direct implications for clinical management of AV. Dietary counseling should be integrated into treatment plans, emphasizing the reduction of high-GI foods and substitution with low-GI alternatives such as whole grains, vegetables, and legumes. These dietary modifications could complement pharmacological treatments and enhance patient outcomes. Healthcare providers, particularly dermatologists and dietitians, can play a pivotal role in educating patients about the relationship between diet and AV. Interdisciplinary approaches combining dermatological care with nutritional guidance may improve adherence to dietary recommendations and reduce AV severity.

### **Public Health Implications**

At the community level, public health campaigns targeting dietary habits among adolescents and young adults could mitigate AV prevalence. Schools and universities can incorporate educational programs on balanced diets and their impact on skin health. Additionally, policymakers could promote the availability of affordable low-GI foods to encourage healthier eating habits.

### **Research Implications**

The study highlights the need for further research exploring the long-term effects of dietary modifications on AV severity. Longitudinal studies could provide deeper insights into causality and the sustained impact of low-GI diets. Additionally, examining the interaction between dietary patterns and other factors, such as stress and physical activity, could offer a more holistic understanding of AV etiology.

#### **4. Limitations of the Study**

While this study provides valuable insights, several limitations must be acknowledged:

##### **a. Cross-Sectional Design**

The cross-sectional nature of the study limits the ability to establish causality. While an association between high-GI diets and AV severity was observed, the directionality of this relationship remains unclear. Future longitudinal studies are needed to confirm causative links.

##### **b. Sample Size and Diversity**

The study was conducted on a relatively small sample (n=66) from a single university. While the total sampling method ensured representation within the target population, it limits the generalizability of the findings to a broader demographic. Expanding the study to multiple universities or diverse regions in Indonesia could strengthen external validity.

##### **c. Self-Reported Dietary Data**

The use of FFQs to assess dietary intake may introduce recall bias. Participants may underreport or overreport their consumption of high-GI foods, affecting the accuracy of dietary assessments. Future research should consider incorporating objective dietary assessment methods, such as 24-hour dietary recalls validated by trained nutritionists or biomarkers of carbohydrate intake, to improve data reliability.

##### **d. Confounding Variables**

Although efforts were made to control for confounding variables such as BMI and smoking, other factors like stress, sleep quality, and skincare practices were not accounted for. These factors could independently influence AV severity and confound the observed associations. This limitation highlights the need for a more holistic approach in future studies that incorporates a wider range of potential contributors to AV, including psychological stress management and skincare habits.

##### **e. Subjectivity in Acne Severity Grading**

Although acne severity was graded by dermatologists, some degree of subjectivity is inherent in visual assessments. The integration of AI-assisted image analysis for acne grading could enhance consistency and reproducibility in future studies.

#### **5. Implications and Future Research Directions**

##### **a. Clinical Implications**

The study's findings have direct implications for the clinical management of AV. Dietary counseling should be integrated into treatment plans, emphasizing the reduction of high-GI foods and substitution with low-GI alternatives such as whole grains, vegetables, and legumes. These dietary modifications could complement pharmacological treatments and enhance patient outcomes.

##### **b. Public Health Implications**

At the community level, public health campaigns targeting dietary habits among adolescents and young adults could mitigate AV prevalence. Schools and universities can incorporate educational programs on balanced diets and their impact on skin health. Additionally, policymakers could promote the availability of affordable low-GI foods to encourage healthier eating habits.

##### **c. Research Implications**

The study highlights the need for further research exploring the long-term effects of dietary modifications on AV severity. In particular, examining the combined influence of diet, stress management, and skincare interventions could provide a more comprehensive understanding of AV etiology. Randomized controlled trials testing the efficacy of holistic intervention programs may yield valuable insights into optimal acne management strategies.

## CONCLUSION

This study confirms a significant association between high-glycemic index (GI) diets and increased severity of acne vulgaris (AV) among university students. High-GI diets were linked to moderate AV, while low-GI diets correlated with mild AV. Subgroup analyses highlighted that younger individuals and males were more affected, likely due to hormonal factors like testosterone and insulin sensitivity. These findings emphasize the importance of dietary interventions in managing AV. Healthcare practitioners should integrate dietary counseling into routine AV management by educating patients on the impact of high-GI foods and providing personalized nutritional guidance. Promoting low-GI foods as part of treatment plans could complement traditional therapies and improve outcomes. Collaboration between dermatologists, nutritionists, and primary care physicians is essential to develop standardized dietary recommendations for acne-prone individuals. Future research should focus on long-term impacts of dietary changes, include diverse populations, and investigate other lifestyle factors influencing AV.

## CONFLICT OF INTEREST

The author(s) declare(s) that there is no conflict of interest.

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