ISSN: 2754-494X

Journal of Dermatology Research Reviews & Reports

SCIENTIFIC Research and Community

Review Article

Open Access

Low Glycemic Index and Glycemic Load Diet in Reducing Acne Vulgaris

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ABSTRACT

Acne vulgaris leads to a massive negative impact on the developmental, emotional, psychological and psychosocial aspects of the person who suffers from the physical sequelae of scarring and hyperpigmentation.

Research articles that have studied the impact and relationship of diet in reducing the severity of acne vulgaris amongst adolescents and young adults are reviewed and analyzed with glycemic index (GI) and glycemic load (GL) diet as the main focus.

The present review does not directly show low GI and GL diet in reducing AV; however, it greatly suggests a strong association of high carbohydrate diet in causing the incidence and severity of AV.

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Received: May 14, 2025; **Accepted:** May 17, 2025; **Published:** June 06, 2025

Keywords: Acne Vulgaris, Glycemic Index, Glycemic Load, Adolescents, Adolescence, Diet

Acne vulgaris (AV) is a non-life-threatening skin condition that affects an estimated 50 million people in the United States; and about 85% of these are in their teens [1]. Moreover, it persists beyond the age of 25 in 3% of men and 12% of women [2]. This skin condition leads to a massive negative impact on the developmental, emotional, psychological and psychosocial aspects of the person who suffers from the physical sequelae of scarring and hyperpigmentation [3]. Specific issues that are prevalent include appearance dissatisfaction and lack of self-confidence which lead to peer avoidance and missed employment opportunities [4]. Therefore, measures in avoiding or reducing severity of acne vulgaris need to be explored to create patient education guidelines to be used by healthcare providers who care for these patients.

The purpose of this paper is to review research articles that have studied the impact and relationship of diet in reducing the severity of acne vulgaris amongst adolescents and young adults. Glycemic index and glycemic load in the diet is of main focus.

The PICO (Population, Intervention, Comparison, Outcome) tool was used in the development of the clinical question. The tool was created by the National Library of Medicine to aid in efficiently searching for the best evidence available to support evidence-based practice. There are many treatment options and interventions proven to be effective to treat acne; however, prevention through diet is not very well established as part of a routine health education amongst the affected population. The PICO question for this paper is: In adolescence and young adults (P), is a low glycemic index and glycemic load diet (I) effective in reducing the incidence of acne vulgaris (O), compared to a normal diet (C)[5]?

Adolescents and young adults are the population in question. Adolescence is the transition from childhood to adulthood between the ages 11-21 years old, while young adults or late adolescence extends to the age of 24 [6]. However, the US Census Bureau defines young adults from the age 18-34 years old.

Low glycemic index and glycemic load diet is the intervention. Glycemic index (GI) is a numerical value assigned to foods which reflects the rise of blood glucose level relatively 2 hours after consumption of food, whereas glycemic load is a "measure of a food's ability to raise blood glucose levels" [7]. High GI foods are assigned to a value between 70-100, medium GI is between 56-69 and low GI is 55 or less [8]. High glycemic index (GI) and glycemic load (GL) diet may have a role in acne stimulation and pathogenesis [9]. On the other hand, a normal diet is the comparison. It is also called a regular diet in which it does not have any dietary restrictions [10].

Reduction of incidence or severity of acne is the desired outcome of the clinical question. Acne vulgaris is an inflammatory skin condition predominantly found on the face and sometimes includes the trunk [2]. It is characterized by open and closed comedones and inflammatory lesions in the form of papules, pustules, and nodules [1]. Predisposing factors include altered androgen/estrogen axis balance, genetics, use of cosmetics, stress and sleep deprivation; tobacco use and alcohol consumption; body mass index and diet [11].

Significance of the Problem

Amongst the teens and young adults with acne, about 6-7% of them have suicidal ideation which may be due to anxiety, depression, low self-esteem and overall poor quality of life [4]. Treatments and interventions are available and effective but very costly. Acne vulgaris fuels the cosmetic industry growth with 2.3 billion USD in 2020 alone for high treatment demand [12]. Diet would be an inexpensive prevention and intervention for acne. There has been a growing interest in diet and acne for the past decade; however, the correlation of low glycemic index diet and reducing severity of acne vulgaris is still ambiguous and uncertain [13].

Theoretical Model to Guide Evidence-Based Research (ACE Star Model)

The ACE Star Model of Knowledge Transformation © model is characterized by diverse forms of knowledge being transformed via a cyclical sequence as research evidence is moved from one cycle to the next. This body of knowledge is then combined with other knowledge and integrated into clinical practice [14]. The model is illustrated as a 5-point star which represents five major stages of knowledge transformation, as explained below:

Discovery Research

In this stage, the primary research which mentions the influence of low glycemic index (GI) and glycemic load (GL) diet in reducing the incidence of acne vulgaris is discovered and will be explored.

Evidence Summary

The primary research discovery will be systematically reviewed and compared to other studies that mention the impact of low GI and GL diet. Consistency of the discovery research will be assessed in this stage and a summary of evidence will be synthesized.

Translation to Guidelines

A summary of evidence will be translated into a succinct clinical guideline which will aid clinicians in counselling acne patients on food choices to reduce acne breakouts.

Practice Integration

The formulated guidelines will be endorsed and disseminated to the organizational practice, patients, and clinicians. Brochures and handouts illustrating the role of diet in acne formation will be utilized.

Process, Outcome Evaluation

A pre and post questionnaire will be handed to patients to evaluate the provider's effectiveness in educating patients regarding diet modification. The instrument will reflect questions geared towards appraising patients' satisfaction in modifying their diet and how it reduces the severity or incidence of acne. Economic analysis will also be evaluated as to the potential savings or costs the new evidence-based practice generates.

Search Strategy and Results

A thorough literature search was conducted in 5 databases including Google Scholar, PubMed, Scopus, CINHAL, and Academic Search Complete. Articles not found were requested via TWU interlibrary loan. MeSH and non-MeSH keywords and combinations terms were used to search for related studies. These search terms include: "diet", "nutrition", "glycemic", "glycemic index", "glycemic load", and "low glycemic index"; "acne", "acne vulgaris", and "pimples"; "adolescents", "teen", "teenagers", "young adults" and "youth". The search included clinical trials, observational studies, and systematic reviews that investigate the link of GI and GL with AV. The search included articles written in English with human participants. Timeframe was between 2016-2021. Older adults, children, foreign language non-human subjects and all articles before 2016 were excluded. There were 6 articles found with 2 cross-sectional studies, 1 prospective study, 1 randomized controlled trial, 1 case-control study, and 1 systematic review. See Figure 1.

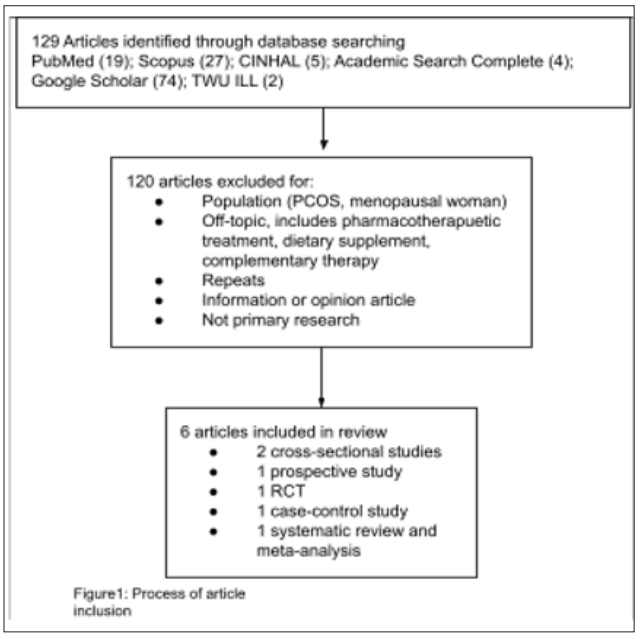

Figure 1: Process of Article Inclusion 19 articles were found in PubMed; 27 articles were found in Scopus; 5 articles were found in CINHAL (Cumulated Index to Nursing and Allied Health Literature; 4 articles found in Academic Search Complete; 74 articles from Google scholar; and 2 articles are from TWU ILL (Texas Woman's InterLoan Library); PCOS (Polycystic ovarian syndrome); RCT (randomized controlled trial)

Level of Evidence

SORT was utilized in grading the level of evidence of each selected article. According to, quality of individual evidence is rated from 1-3. Level 1 evidence consists of systematic reviews, high-quality RCTs, and high-quality prognostic or diagnostic cohort studies [15]. Level 2 includes studies aimed at improving morbidity and mortality, quality of life but have lower quality clinical trials or case-control study design. Level 3 is based on opinion, bench research, consensus guideline, clinical experience or case series. SORT includes assigning A, B, C to a body of evidence depending on consistency and quality evidence, with A being the consistent and good-quality.

Literature Review

One study is a parallel RCT with 66 participants investigating the biochemical changes of subjects with moderate to severe acne following a low GI and low GL diet plan for 2 weeks [9]. Using the SORT algorithm, this literature demonstrates level evidence 1. This is the only interventional study being reviewed. The study found that low GI and GL diets decrease biochemical factors that induce acne. The disadvantage of this study is that it is conducted in a short period of time.

Three studies identified that high GI and GL food consumption are found on subjects with AV. Two are cross-sectional in design and 1 prospective. The first study, with 86 subjects, is analytical comparing GI and GL and other dietary factors using blood levels between subjects with AV and without [16]. The second study is a

prevalence study of 464 adolescents on which food consumption was collected using a food frequency questionnaire (FFQ) [17]. The third study is a prospective study with 202 participants which also used an FFQ [18]. The disadvantage of the 3 studies is that it only shows a correlation of high GI/GL consumption and incidence of AV; however, they all support in answering the clinical. Also, the prospective study failed to mention timeframe and follow-up. Level 2 evidence is given to these articles since it does not meet criteria for Level 1.

A case-control study looked into the effect of food consumption habits and anthropometric measurements in 106 subjects of which 53 had acne. The study found a significant correlation of acne severity and increased carbohydrate intake in patients with acne [19]. However, the age range (13-44 y.o) overlaps the population in question. Due to the nature of this study, it is awarded level evidence of 2.

One article did a systematic review and meta-analysis on 14 studies on the effect of dietary GI and GL on acne using PRISMA guidelines [20]. It included 3 RCTs and 11 observational studies. The review suggested that low GI/GL diets might improve acne. The disadvantage of this article is that it has a low number of studies involved in the review. However, all the studies were of high quality with reference to Cochrane collaboration's tool, hence level of evidence is 1 [21].

Acknowledgments
The authors would like to express gratitude to Elaine Cox for helping me narrow down my research topic. Thanks to Woody Evans for helping discern research articles vs information articles and any bias they may have. The authors would also like to thank Marilyn Goff for helping with the search strategy for the topic

Declarations
Funding
Not applicable

Availability of Data and Materials
All data used are available in the appendices. No additional data available

Ethics Approval and Consent to Participate
Not applicable

Consent for Publication
Not applicable

Competing Interest
None

Authors' Contribution
Concept, analysis, interpretation, literature review and writing the article: Dyll turner; Critical review: Dr. Lillian Ehiemua-Pope

Appendix A
Summary of Primary Sources of Evidence

Citation of Evidence	Study Question or Hypothesis	Study Design	Sample/ Setting	Independent and Dependent Variables & Tools Used	Data Collection & Analysis	Findings	Recommendation / Implications	Level of Evidence
Cerman, et. al. (2016) [16]	Associations among dietary glycemic index, glycemic load, milk consumption, insulin resistance and adiponectin levels in the	Cross-sectional	50 young nonobese patients with acne vulgaris and mean age of 18.8 were recruited	**Independent variables:** the presence and absence of acne vulgaris **Dependent:** BMI, glycemic index, serum adiponectin, insulin, IGF-1, IGFBP-3 **Tools used**: adiponectin ELISA kit,	12- hour fasting blood samples were taken between 9-11am.Serum glucose level measurements were performed with a Roche/ Hitachi analyzer using an enzymatic method. Insulin concentrations were measured with an electrochemiluminescence immunoassay.	Glycemic index and glycemic load levels were significantly higher and adiponectin levels were significantly lower in patients with acne than in control subjects. There was an inverse correlation between serum adiponectin concentration and glycemic index	Further research on adiponectin levels in patients with acne in terms of development of insulin resistance might be important. Future direction: a study looking at the effect of controlling the dietary glycemic	2

	pathogenesis of acne vulgaris		in Sisli Hamidye Etfal Training and Research Hospital, Istanbul, Turkey; 36 (mean age = 19.06) healthy control subjects are hospital staff volunteers.	Roche/Hitachi analyzer	IGF-1 and IGFBP-3 levels were measured with an immunometric chemiluminescence assay Analysis was done to compare the group with acne vs controlled in terms of GI, GL, insulin, adiponectin, IGF-1, IGPBP-3, HOMA-IR. Another analysis was done on the subgroup of patients with acne comparing the above parameters according to the severity of acne (mild, moderate, severe).		index will resolve or reduce the severity of the acne	
Kutlu, et. al. (2020) [18]	To evaluate the effect of insulin index and dietary factors in patients with acne vulgaris	Prospective study	202 subjects with acne vulgaris and 172 control subjects with similar age, gender and demographic characteristics	**Independent variables**: the presence and absence of acne vulgaris **Dependent:** Amount of serving of certain of food/week (cola, chicken, sujuk, feta cheese, peanuts, peanuts, pasta, grapes) **Tools:** food frequency questionnaire, GAGS	Standardized food frequency questionnaires were used to gather the data on dietary habits in patients with acne vulgaris and control group. Consumption of certain foods were compared between patients with AV and control group.	The risk for acne was higher among those consuming more than 3 servings per week of cola, instant coffee with powdered milk, feta cheese and 1 serving per week of peanut; while risk for acne was lower among those consuming more than 3 servings per week of chicken meat and 1 serving per week of sujuk. In this study, the consumption of foods with a higher insulin index value and glycemic index such as cola, feta cheese, and peanuts were	It may be useful to take into consideration the value of insulin index along with the glycemic index value of the foods in question to evaluate the relationship between acne vulgaris and dietary factors.	2

						significantly higher in patients with acne vulgaris.		
Okoro, et. al. (2016) [17]	To identify possible associations of diet with AV in Nigeria	Cross-sectional study	464 adolescents randomly selected in 4 secondary schools (2 public schools, 2 private schools) in Ibadan, Nigeria. Mean age was 13.6±3.6 years, 67% were females.	**Independent**: the presence and absence of acne vulgaris **Dependent:** daily intake of certain food (milk, banana, fried beef, corn, cakes, glycemic index) and food groups (fried, fatty, snacks, fruits); BMI **Tools:** modified food frequency questionnaire from the US National Health and Nutrition Examination Survey	Each participant marked how often he or she had eaten a particular food in the last 12 months. The questionnaires were administered by three doctors in the dermatology unit, who had been trained to do so. The face of each participant was examined separately under good light for the presence of acne lesions. BMI was calculated for each participant. Analysis was done between the presence of acne and at least a daily intake of various foods in question.	Prevalences of acne were higher among those who reported an at least daily intake of milk as beverage, corn, fried beef, and cake. However, acne was less common among those students who reported an at least daily intake of bananas. Following classification of the foods by GI, subjects with acne were found to consume foods with a higher GI than subjects without acne (64.2% vs. 35.8%). However, the difference was not statistically significant	An interventional dietary study will be required to ascertain the effects of certain foods in AV. The intervention can be low GI since in the findings, subjects with AV consume high GI foods	2
Burris et al. (2018) [9]	To examine changes in biochemical factors associated with acne among adults with moderate to severe acne after following a low GI and GL diet or	Parallel-RCT design to compare effects of low GI and GL diet to usual diet after 2 weeks	66 participants randomly selected in the greater New York City Area with the mean age of	**Independent:** Usual eating plan, low GI/GL diet **Dependent:** glucose, insulin, insulin-like growth factor (IGF-1), insulin-like growth factor binding protein (IGFBP-3), insulin resistance **Tools:** food and	Anthropometric measurements were collected using the tools mentioned; blood drawn from fasting participants to measure insulin, glucose, IGF-1 and IGFBP pre-post intervention; pictures were taken of the front and side views of the face to assess acne and ensure that all acne lesions were	IGF-1 concentrations decreased significantly among participants randomized to a low GI and GL diet between pre- and post intervention time points (P=0.049). There were no differences in changes in glucose, insulin, or IGFBP-3 concentrations or insulin resistance between treatment groups after 2 weeks.	Further research of a longer duration should examine whether a low GI and GL diet would result in a clinically meaningful difference in IG-F concentrations leading to a reduction in acne.	1

	usual eating plan for 2 weeks		22±4. They were randomly allocated to the low GI/GL diet or usual eating plan	beverage record, digital scale, digital stadiometer, Gulick II constant-tension measuring tape, Quad Scan 4000 multi frequency analyzer, Gourmet Weigh food scale, high resolution camera, Investigator Global Assessment Scale	counted and graded by size and severity during screening, pre and post intervention. Only participants with moderate or severe acne during the screening visit were eligible. The same dermatologist performed all acne assessments to assure reliability of acne lesion counting. Analysis was done from the clinical outcomes, biochemical factors associated with acne and insulin resistance over a 2-week period.	Carbohydrate, available carbohydrate, percent energy from carbohydrate, GI, and GL decreased significantly among participants following a low GI/GL diet between the pre- and post intervention time points. There were no differences in changes in body composition comparing groups.		
Kara & Osdemir (2020) [19]	To determine the effect of various possible factors such as food consumption habits and anthropometric measurements in the etiology and severity of acne	Case-control study	53 acne vulgaris patients (age 13-44 mean age 24.47±6.89) and 53 age, gender, and ethnicity-matched controls (mean age 26.25±7.57) with a total of 106 subjects.	**Independent:** the presence and absence of acne vulgaris **Dependent:** milk, yogurt, kefir, ice cream, carbohydrate %, fat %, protein % **Tools:** GAGS	Data collection involved face-to-face interview methods; anthropometric measurements including height, body weight, BMI, and body fat percentage were collected using the BIA method; a 3-day consumption record was asked from the participants. Food consumption of the participants was recorded in the Nutrition Information System 7 full version; frequency of food consumption including 5 foods was	There was no significant difference between the acne and control groups in terms of age, body weight, height, BMI, and body fat percentage; cheese consumption was higher in the acne group than in the control group and there was a statistically significant difference between the two groups. No significant association was found with the intakes of milk, yogurt, ice cream, kefir, carbohydrate, fat, and protein. There was a statistically positive correlation between	There was a statistically positive correlation between acne severity and carbohydrate and cheese intake. The authors think that the dietary intake of these foods may have increased acne severity by exhibiting an inflammatory effect. Giving weight to carbohydrates with low glycemic index in the nutritional pattern may help reduce	2

			Department of Nutrition and Dietetics, Liv Hospital, Ankara, Turkey		recorded to determine consumption of milk and dairy. SPSS version 17 was used to do statistical analysis. Descriptive analysis was done to elicit the percentage, mean and SD for quantitative data. The Pearson's correlation test was used to evaluate the correlation between acne score and anthropometric measurements, milk, and dairy products and continuous variables such as protein, fat and carbohydrate ratio	acne score and carbohydrate consumption and a statistically negative correlation between acne score and fat consumption. According to the results, it was found that acne severity increased as carbohydrate consumption increased in the acne group; however, acne severity did not increase as fat consumption increased. There was a statistically no correlation between acne score and milk and dairy products, protein consumption, and body mass index with body fat percentage	acne lesions and their severity. Future research is needed to determine the relationship between eating habits and acne and acne severity.	

Note: AV - acne vulgaris; GI -glycemic index; GL-glycemic load; IGF-1 -insulin-like growth factor; IGFBP-3-insulin-like growth factor binding protein; BMI-body mass index; HOMA-IR -homeostatic model assessment for insulin resistance; ELISA- enzyme-linked immunosorbent assay; RCT-randomized control trial; GAGS - Global Acne Grading Scale; BIA-bioelectrical impedance analysis; SPSS-Statistical Package for Social Sciences; SD - standard deviation

Appendix B
Summary of Systematic Reviews (SR)

Citation of SR	Objective,Aim, Purpose	Search Strategy	Inclusion/ Exclusion Criteria	Data Extraction and Analysis	Results	Recommendation/ Implication	Level of Evidence
Sakhaei & Mohsenpour (2019) [20]	Different findings on glycemic indices led to the investigation of the effect of the dietary GI and GL on AV by a systematic review and meta-analysis	Publications indexed in PubMed, Scopus, and Google Scholar up to September 2018. Using MeSH and non-MeSH keywords 1. "glycemic", "glycemic load", "GL", "glycemic index", "GI", "glycemic diet", "GL diet", "GI diet", "glycaemic" and 2. "Acne", "acne vulgaris	Inclusion: Clinical trials with human participants, RCT, mild to severe acne patients, low GI and GL diet for intervention. Observational studies that compared GI or GL of diet for acne patients with healthy control group and compared the chance of developing acne between participants with highest dietary GI or GL to those with the lowest dietary GI and GL Exclusion: nonhuman participants and clinical trials and observational studies that did not meet inclusion criteria	The first author's last name, publication year, location, sample size, participants' gender, age range, recruitment procedure, acne grading system, variables adjusted in the statistical analysis and the dietary assessment method. Analysis: In RCTs, mean ±SD values were obtained for acne severity pre and post intervention. These values were then used to calculate the mean changes (standard error) from the baseline; in observational studies, mean ± SD for dietary GI and/ or GL score were extracted from AV cases and healthy controls. The possible sources of heterogeneity were explored using subgroup analysis. Sensitivity analysis was done by sequentially excluding each study from the overall meta-analysis	9 out of 15 studies were eligible for systematic review of clinical trials and bservational studies designs. The meta-analysis of 3 studies clinically assessed the effect on acne and showed that a diet with lower GI/ GL reduced the acne severity. The analysis of 6 bservational studies showed that dietary habit with higher GI might not affect the acne severity in patients with AV	The present systematic review and meta-analysis suggested that low GI/GL diets might improve AV. Furthermore, dietary GL might predict AV better than the dietary GI. Future well-designed prospective investigations are still needed to confirm these results	1

Note: GI-glycemic index; GL-glycemic load; RCT-randomized control trial; AV-acne vulgaris; ±SD-standard deviation

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