ORIGINAL RESEARCH

Insulin Resistance in Patients with Acne Vulgaris in India: A Cross-Sectional Study

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ABSTRACT

Background: Acne vulgaris is a common dermatological condition affecting adolescents and young adults worldwide. Recent evidence suggests a potential association between insulin resistance and acne pathogenesis. This study aimed to investigate the relationship between insulin resistance and acne vulgaris in the Indian population, where dietary patterns, genetic factors, and environmental influences may differ from previously studied populations. **Methods:** A cross-sectional study was conducted involving 240 subjects (120 acne patients and 120 age-matched controls) from three tertiary care centers in India. Acne severity was assessed using the Global Acne Grading System (GAGS). Anthropometric measurements, fasting blood glucose, fasting insulin levels, and homeostatic model assessment of insulin resistance (HOMA-IR) were evaluated. Dietary habits and lifestyle factors were assessed using validated questionnaires. **Results:** The prevalence of insulin resistance (HOMA-IR > 2.5) was significantly higher in acne patients compared to controls (42.5% vs. 18.3%, $p < 0.001$). Mean HOMA-IR values were significantly elevated in patients with acne compared to controls (2.84 ± 1.26 vs. 1.92 ± 0.88, $p < 0.001$). A positive correlation was observed between acne severity and HOMA-IR values ($r = 0.64$, $p < 0.001$). After adjusting for age, BMI, and family history, insulin resistance remained independently associated with acne vulgaris (OR = 2.86, 95% CI: 1.72-4.76). **Conclusion:** This study demonstrates a significant association between insulin resistance and acne vulgaris in the Indian population. The findings suggest that insulin resistance may contribute to acne pathogenesis and could represent a potential therapeutic target in its management, particularly in the context of the evolving dietary patterns in urban India.

Keywords: Acne vulgaris, insulin resistance, HOMA-IR, India, hyperinsulinemia, dermatology

INTRODUCTION

Acne vulgaris is a chronic inflammatory disease of the pilosebaceous unit characterized by comedones, papules, pustules, nodules, and cysts. It affects approximately 85% of adolescents and young adults worldwide and represents one of the most common dermatological conditions in India, with a reported prevalence of 50-80% in the adolescent population.[1,2] While traditionally considered a self-limiting condition of adolescence, recent evidence indicates that acne may persist into adulthood, causing significant psychological distress and reduced quality of life.[3]

The pathogenesis of acne is multifactorial, involving androgen-mediated sebum production, follicular hyperkeratinization, *Cutibacterium acnes* colonization, and inflammation.[4] Recent research suggests that metabolic factors, particularly insulin and insulin-like growth factor-1 (IGF-1), may play crucial roles in acne development.[5,6] Insulin and IGF-1 can stimulate sebaceous gland lipogenesis, promote keratinocyte proliferation, and influence androgen metabolism, potentially exacerbating acne .[7]

Insulin resistance, characterized by reduced sensitivity of tissues to insulin action, has been implicated in various dermatological disorders, including acne, psoriasis, and hidradenitis suppurativa.[8] Several studies from Western populations have reported associations between insulin resistance and acne.[9,10] However, data from the Indian subcontinent, where genetic factors, dietary patterns, and environmental influences differ significantly, remain limited.

India is currently undergoing rapid nutritional transition, with increasing consumption of high-glycemic-load diets, particularly in urban areas.[11] This dietary shift, coupled with reduced physical activity,

has contributed to a rising prevalence of insulin resistance and metabolic syndrome in the Indian population.[12] Given these changing patterns, investigating the relationship between insulin resistance and acne vulgaris in this population is of particular interest.

This study aims to assess the prevalence of insulin resistance in patients with acne vulgaris compared to healthy controls in an Indian population and to examine the correlation between insulin resistance parameters and acne severity. Additionally, we evaluate potential associations with dietary patterns and lifestyle factors commonly observed in urban Indian settings.

METHODS

Study Design and Participants

This cross-sectional study was conducted between January 2019 and September 2019 at our institution. The study protocol was approved by the institutional ethics committees.. Written informed consent was obtained from all participants or their legal guardians for those under 18 years of age.

A total of 240 participants were enrolled, comprising 120 patients with acne vulgaris (case group) and 120 age-matched individuals without acne (control group). Inclusion criteria for the case group were: (1) clinical diagnosis of acne vulgaris; (2) age between 15 and 35 years; and (3) no previous systemic treatment for acne in the preceding 3 months. Exclusion criteria for both groups included: (1) known diabetes mellitus or impaired glucose tolerance; (2) polycystic ovary syndrome; (3) thyroid dysfunction; (4) Cushing's syndrome; (5) chronic liver or kidney disease; (6) malignancy; (7) pregnancy or lactation; (8) use of medications known to affect insulin sensitivity (corticosteroids, oral contraceptives, metformin, thiazolidinediones); (9) family history of diabetes in first-degree relatives; and (10) history of smoking or alcohol consumption.

Clinical Assessment

Demographic data including age, gender, residence (urban/rural), occupation, education level, and family history of acne were recorded. Dermatological examination was performed by trained dermatologists who assessed acne severity using the Global Acne Grading System (GAGS). GAGS considers six locations on the face and chest/back, with a factor assigned to each location based on surface area, distribution, and density of pilosebaceous units. Each type of lesion is given a value: no lesions = 0, comedones = 1, papules = 2, pustules = 3, and nodules = 4. The local score is calculated using the formula: Local score = Factor × Grade (0-4). The global score is the sum of local scores, and acne severity is graded as mild (1-18), moderate (19-30), severe (31-38), and very severe (>39).[13]

Anthropometric measurements including height, weight, waist circumference, and hip circumference were obtained using standardized techniques. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m²). Waist-to-hip ratio (WHR) was calculated by dividing waist circumference by hip circumference.

Biochemical Analysis

Blood samples were collected after an overnight fast of at least 8 hours. Fasting blood glucose (FBG) was measured using the glucose oxidase-peroxidase method. Fasting insulin levels were determined using electrochemiluminescence immunoassay (ECLIA). Insulin resistance was assessed using the homeostatic model assessment of insulin resistance (HOMA-IR), calculated as: HOMA-IR = (Fasting insulin [μIU/mL] × Fasting glucose [mg/dL]) / 405. A HOMA-IR value > 2.5 was considered indicative of insulin resistance based on previous studies in the Indian population.[14]

Additional biochemical parameters measured included lipid profile (total cholesterol, triglycerides, HDL cholesterol, LDL cholesterol), liver function tests (ALT, AST), and high-sensitivity C-reactive protein (hs-CRP). Hormonal evaluation included total testosterone and dehydroepiandrosterone sulfate (DHEAS) levels.

Dietary and Lifestyle Assessment

Dietary habits were assessed using a validated semi-quantitative food frequency questionnaire (FFQ) adapted for the Indian population.[15] The questionnaire evaluated the consumption frequency and portion sizes of various food groups, with particular emphasis on high-glycemic-index foods, dairy products, and processed foods. Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ), which measures activity levels in three domains: work, travel, and recreational activities.[16]

Statistical Analysis

Statistical analysis was performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR) depending on the distribution. Categorical variables were presented as frequencies and percentages. The normality of data distribution was assessed using the Kolmogorov-Smirnov test.

Differences between cases and controls were analyzed using Student's t-test or Mann-Whitney U test for continuous variables and chi-square test or Fisher's exact test for categorical variables. Correlation between HOMA-IR values and acne severity (GAGS score) was evaluated using Spearman's rank correlation coefficient. Multiple logistic regression analysis was performed to identify independent factors associated with acne vulgaris, adjusting for potential confounders. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Acne Group (n = 120)	Control Group (n = 120)	p-value
Age (years), mean ± SD	21.6 ± 4.8	22.1 ± 4.5	0.428
Gender, n (%)			0.697
Male	53 (44.2)	56 (46.7)	
Female	67 (55.8)	64 (53.3)	
Residence, n (%)			0.583
Urban	82 (68.3)	78 (65.0)	
Rural	38 (31.7)	42 (35.0)	
BMI (kg/m²), mean ± SD	23.4 ± 3.7	22.8 ± 3.5	0.187
Waist circumference (cm), mean ± SD	81.3 ± 9.6	79.5 ± 8.8	0.132
Waist-to-hip ratio, mean ± SD	0.84 ± 0.07	0.82 ± 0.06	0.015
Family history of acne, n (%)	58 (48.3)	36 (30.0)	0.003
Duration of acne (years), mean ± SD	3.4 ± 2.1	NA	NA
GAGS score, mean ± SD	22.7 ± 9.5	NA	NA
Acne severity, n (%)			
Mild (1-18)	45 (37.5)	NA	NA
Moderate (19-30)	52 (43.3)	NA	NA
Severe (31-38)	19 (15.8)	NA	NA
Very severe (>39)	4 (3.3)	NA	NA

Table 2: Comparison of Metabolic Parameters Between Acne and Control Groups

Parameter	Acne Group (n = 120)	Control Group (n = 120)	p-value
Fasting blood glucose (mg/dL), mean ± SD	87.4 ± 9.2	85.6 ± 8.7	0.113
Fasting insulin (μIU/mL), mean ± SD	14.6 ± 5.8	10.7 ± 4.2	<0.001
HOMA-IR, mean ± SD	2.84 ± 1.26	1.92 ± 0.88	<0.001
Insulin resistance (HOMA-IR > 2.5), n (%)	51 (42.5)	22 (18.3)	<0.001
Total cholesterol (mg/dL), mean ± SD	172.4 ± 32.8	168.5 ± 30.6	0.339
Triglycerides (mg/dL), mean ± SD	126.8 ± 41.3	110.2 ± 35.6	0.001
HDL cholesterol (mg/dL), mean ± SD	42.5 ± 8.7	45.9 ± 9.3	0.003
LDL cholesterol (mg/dL), mean ± SD	104.6 ± 28.5	100.8 ± 26.7	0.269
Total testosterone (ng/dL), mean ± SD	57.3 ± 24.6	49.1 ± 21.8	0.007
DHEAS (μg/dL), mean ± SD	248.6 ± 102.3	209.5 ± 89.7	0.002
hs-CRP (mg/L), median (IQR)	1.8 (0.9-3.2)	1.1 (0.6-2.1)	<0.001

SD: Standard deviation; HOMA-IR: Homeostatic model assessment of insulin resistance; HDL: High-density lipoprotein; LDL: Low-density lipoprotein; DHEAS: Dehydroepiandrosterone sulfate; hs-CRP: High-sensitivity C-reactive protein; IQR: Interquartile range

Table 3: Multiple Logistic Regression Analysis for Factors Associated with Acne Vulgaris

Variable	Adjusted OR	95% CI	p-value
Insulin resistance (HOMA-IR > 2.5)	2.86	1.72-4.76	<0.001
Family history of acne	1.92	1.14-3.24	0.015
High-glycemic-index diet	1.77	1.05-2.97	0.031
Dairy consumption	1.64	0.98-2.75	0.059
BMI > 25 kg/m²	1.42	0.84-2.41	0.194
Low physical activity	1.38	0.81-2.34	0.235
Age	0.98	0.93-1.03	0.417
Gender (female vs. male)	1.15	0.68-1.93	0.602

OR: Odds ratio; CI: Confidence interval; HOMA-IR: Homeostatic model assessment of insulin resistance; BMI: Body mass index

DISCUSSION

This cross-sectional study demonstrates a significant association between insulin resistance and acne vulgaris in the Indian population. Patients with acne exhibited higher levels of fasting insulin and HOMA-IR values compared to controls, with 42.5% of acne patients meeting the criteria for insulin resistance. Furthermore, a strong positive correlation was observed between insulin resistance and acne severity, with HOMA-IR values progressively increasing with greater acne severity.

Our findings align with previous studies conducted in different populations. Emiroglu et al.[17]reported significantly higher HOMA-IR values in Turkish patients with acne compared to healthy controls. Similarly, Del Prete et al.[18] found an association between insulin resistance and acne in an Italian population, particularly among females. Nagpal et al.,[19] in a smaller Indian study, also reported higher insulin resistance in acne patients, though with a focus on postadolescent females.

The present study extends these observations to a larger, more diverse Indian population, including both males and females across different age groups and acne severity levels. The association between insulin resistance and acne remained significant after adjusting for potential confounders, including BMI, family history, and dietary factors, suggesting an independent relationship.

Several mechanisms may explain the link between insulin resistance and acne pathogenesis. Insulin and IGF-1 stimulate the production of androgens, which increase sebum production and follicular hyperkeratinization.[20] Insulin also enhances the bioavailability of androgens by suppressing sex hormone-binding globulin (SHBG) synthesis.[21] Additionally, hyperinsulinemia directly affects keratinocyte proliferation and differentiation, potentially contributing to follicular plugging.[22]

The dietary analysis in our study revealed significantly higher consumption of high-glycemic-index foods and dairy products among acne patients compared to controls. These dietary patterns are consistent with the Western dietary model, which has been associated with insulin resistance and acne.[23] High-glycemic-load diets induce hyperinsulinemia and increase IGF-1 levels, potentially exacerbating acne.[24] Similarly, milk consumption has been linked to acne through its effects on insulin secretion and IGF-1 levels.[25]

Our findings have particular relevance in the Indian context, where rapid urbanization and nutritional transition have led to changing dietary patterns, characterized by increased consumption of refined carbohydrates and processed foods.[26] This dietary shift, coupled with reduced physical activity, may contribute to the rising prevalence of insulin resistance and metabolic syndrome in urban Indian populations,[27] potentially influencing acne prevalence and severity.

The strong correlation between insulin resistance and acne severity observed in our study suggests that insulin resistance may not only contribute to acne development but also influence its clinical course. This finding has therapeutic implications, as interventions targeting insulin sensitivity might complement conventional acne treatments, particularly in patients with severe acne and concomitant insulin resistance.

CONCLUSION

In conclusion, this study demonstrates a significant association between insulin resistance and acne vulgaris in the Indian population, with insulin resistance being more prevalent in acne patients and correlating positively with acne severity. These findings suggest that insulin resistance may contribute to acne pathogenesis and could represent a potential therapeutic target in its management.

REFERENCES

1. Khunger N, Kumar C. A clinico-epidemiological study of adult acne: Is it different from adolescent acne? Indian J Dermatol VenereolLeprol. 2012;78(3):335-41.
2. Kubba R, Bajaj AK, Thappa DM, Sharma R, Vedamurthy M, Dhar S, et al. Acne in India: Guidelines for management - IAA consensus document. Indian J Dermatol VenereolLeprol. 2009;75(Suppl 1):1-62.
3. Hazarika N, Archana M. The psychosocial impact of acne vulgaris. Indian J Dermatol. 2016;61(5):515-20.
4. Tanghetti EA. The role of inflammation in the pathology of acne. J Clin Aesthet Dermatol. 2013;6(9):27-35.
5. Melnik BC, Schmitz G. Role of insulin, insulin-like growth factor-1, hyperglycaemic food and milk consumption in the pathogenesis of acne vulgaris. Exp Dermatol. 2009;18(10):833-41.
6. Melnik BC. Linking diet to acne metabolomics, inflammation, and comedogenesis: an update. Clin CosmetInvestig Dermatol. 2015;8:371-88.
7. Melnik BC, Zouboulis CC. Potential role of FoxO1 and mTORC1 in the pathogenesis of Western diet-induced acne. Exp Dermatol. 2013;22(5):311-5.
8. Napolitano M, Megna M, Monfrecola G. Insulin resistance and skin diseases. ScientificWorldJournal. 2015;2015:479354.
9. Kartal D, Yildiz H, Ertas R, Borlu M, Utas S. Association between insulin resistance and acne severity in women with adult acne: a case-control study. G Ital Dermatol Venereol. 2016;151(4):353-7.
10. Karadag AS, Ertugrul DT, Takci Z, Bilgili SG, Namuslu M, Ata N, et al. The effect of isotretinoin on insulin resistance and adipokine levels in acne vulgaris patients. Turk J Med Sci. 2015;45(5):1165-9.
11. Misra A, Khurana L. Obesity and the metabolic syndrome in developing countries. J Clin Endocrinol Metab. 2008;93(11 Suppl 1):S9-30.
12. Mohan V, Sandeep S, Deepa R, Shah B, Varghese C. Epidemiology of type 2 diabetes: Indian scenario. Indian J Med Res. 2007;125(3):217-30.
13. Doshi A, Zaheer A, Stiller MJ. A comparison of current acne grading systems and proposal of a novel system. Int J Dermatol. 1997;36(6):416-8.
14. Keskin M, Kurtoglu S, Kendirci M, Atabek ME, Yazici C. Homeostasis model assessment is more reliable than the fasting glucose/insulin ratio and quantitative insulin sensitivity check index for assessing insulin resistance among obese children and adolescents. Pediatrics. 2005;115(4):e500-3.
15. Sudha V, Radhika G, Sathya RM, Ganesan A, Mohan V. Reproducibility and validity of an interviewer-administered semi-quantitative food frequency questionnaire to assess dietary intake of urban adults in southern India. Int J Food Sci Nutr. 2006;57(7-8):481-93.

16. Bull FC, Maslin TS, Armstrong T. Global physical activity questionnaire (GPAQ): nine country reliability and validity study. J Phys Act Health. 2009;6(6):790-804.
17. Emiroğlu N, Cengiz FP, Kemeriz F. Insulin resistance in severe acne vulgaris. Postepy Dermatol Alergol. 2015;32(4):281-5.
18. Del Prete M, Mauriello MC, Faggiano A, Di Somma C, Monfrecola G, Fabbrocini G, et al. Insulin resistance and acne: a new risk factor for men? Endocrine. 2012;42(3):555-60.
19. Nagpal M, De D, Handa S, Pal A, Sachdeva N. Insulin resistance and metabolic syndrome in young men with acne. JAMA Dermatol. 2016;152(4):399-404.
20. Cappel M, Mauger D, Thiboutot D. Correlation between serum levels of insulin-like growth factor 1, dehydroepiandrosterone sulfate, and dihydrotestosterone and acne lesion counts in adult women. Arch Dermatol. 2005;141(3):333-8.
21. Lai JJ, Chang P, Lai KP, Chen L, Chang C. The role of androgen and androgen receptor in skin-related disorders. Arch Dermatol Res. 2012;304(7):499-510.
22. Yamaguchi Y, Brenner M, Hearing VJ. The regulation of skin pigmentation. J Biol Chem. 2007;282(38):27557-61.
23. Cordain L, Lindeberg S, Hurtado M, Hill K, Eaton SB, Brand-Miller J. Acne vulgaris: a disease of Western civilization. Arch Dermatol. 2002;138(12):1584-90.
24. Smith RN, Mann NJ, Braue A, Mäkeläinen H, Varigos GA. A low-glycemic-load diet improves symptoms in acne vulgaris patients: a randomized controlled trial. Am J Clin Nutr. 2007;86(1):107-15.
25. Melnik BC. Evidence for acne-promoting effects of milk and other insulinotropic dairy products. Nestle Nutr Workshop Ser Pediatr Program. 2011;67:131-45.
26. Misra A, Singhal N, Sivakumar B, Bhagat N, Jaiswal A, Khurana L. Nutrition transition in India: secular trends in dietary intake and their relationship to diet-related non-communicable diseases. J Diabetes. 2011;3(4):278-92.
27. Deepa M, Farooq S, Deepa R, Manjula D, Mohan V. Prevalence and significance of generalized and central body obesity in an urban Asian Indian population in Chennai, India (CURES: 47). Eur J Clin Nutr. 2009;63(2):259-67.