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ORIGINAL ARTICLE

Exploring the association between acne and metabolic syndrome in patients from North-Eastern India: a cross-sectional study in a tertiary care setting

Explorando a associação entre acne e síndrome metabólica em doentes do nordeste da Índia: um estudo transversal num ambiente de cuidados terciários

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Abstract

Objectives: Acne vulgaris is increasingly considered not just as a dermatological condition, but as a manifestation of broader systemic disturbances, including metabolic imbalance and hormonal dysregulation, with emerging evidence linking it to insulin resistance and metabolic syndrome. This study aimed to evaluate the prevalence of metabolic syndrome and insulin resistance among patients with acne vulgaris in a tertiary care setting in North-Eastern India, and to explore their relation with acne severity, body mass index (BMI), and selected biochemical parameters. **Methods:** A cross-sectional study was conducted in acne patients attending the outpatient department of dermatology at a tertiary care center in North-Eastern India. Clinical grading of acne severity was performed, along with anthropometric assessments and biochemical evaluation, which included serum insulin, fasting glucose, thyroid function, sex hormones, and vitamin D levels. Metabolic syndrome was diagnosed based on standard clinical criteria, and insulin resistance was calculated using the homeostasis model assessment. Associations were analyzed using non-parametric statistical tests, with a significance threshold of $p < 0.01$. **Results:** Among the 73 participants, mean age 22.2 ± 3.85 years, the majority (35.6%, n = 26) with a severe acne, 31.5% (n = 23) were overweight or obese, but only 5.47% (n = 4) met the diagnostic criteria for metabolic syndrome and 6.85% (n = 5) for insulin resistance. Despite the elevated BMI in a subset, no statistically significant association was observed between acne severity and either metabolic syndrome or insulin resistance. **Conclusion:** In this studied population, no significant association was found between acne severity and metabolic syndrome or insulin resistance, and these findings highlight acne's complex and context-dependent pathophysiology. Given the study's limitations (cross-sectional design and lack of matched controls), results should be interpreted within the region's unique clinical and nutritional landscape. Further research is needed in diverse populations, particularly in under-represented regions.

***Keywords*:** Acne vulgaris. Metabolic syndrome. Insulin resistance. Body mass index. Mechanistic target of rapamycin complex 1.

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Resumo

Objectivos: A acne vulgar é cada vez mais considerada não só uma condição dermatológica, mas também uma manifestação de distúrbios sistémicos mais amplos, incluindo o desequilíbrio metabólico e a desregulação hormonal, com evidências emergentes que a associam à resistência à insulina e à síndrome metabólica. Este estudo teve como objetivo avaliar a prevalência da síndrome metabólica e da resistência à insulina entre os doentes com acne vulgar num ambiente de cuidados terciários no nordeste da Índia e explorar a sua relação com a gravidade da acne, o índice de massa corporal e parâmetros bioquímicos selecionados. **Métodos:** Foi realizado um estudo transversal em doentes com acne atendidos no ambulatório de Dermatologia de um centro de cuidados terciários no nordeste da Índia. Foi realizada a classificação clínica da gravidade da acne, juntamente com avaliações antropométricas e bioquímicas, que incluíram a insulina sérica, a glicemia em jejum, a função tiroideia, as hormonas sexuais e os níveis de vitamina D. A síndrome metabólica foi diagnosticada com base em critérios clínicos padrão e a resistência à insulina foi calculada através do modelo de avaliação da homeostasia. As associações foram analisadas através de testes estatísticos não paramétricos, com um limiar de significância de $p < 0.01$. **Resultados:** Entre os 73 participantes, com uma média de idades de 22.2 ± 3.85 anos, a maioria (35.6%, n = 26) apresentava acne grave, 31.5% (n = 23) tinham excesso de peso ou obesidade, mas apenas 5.47% (n = 4) preenchiam os critérios de diagnóstico de síndrome metabólica e 6.85% (n = 5) de resistência à insulina. Apesar do índice de massa corporal elevado num subconjunto, não foi observada uma associação estatisticamente significativa entre a gravidade da acne e a síndrome metabólica ou a resistência à insulina. **Conclusão:** Nesta população estudada, não foi encontrada uma associação significativa entre a gravidade da acne e a síndrome metabólica ou a resistência à insulina, e estes achados realçam a fisiopatologia complexa e dependente do contexto da acne. Dadas as limitações do estudo (desenho transversal e ausência de controlos emparelhados), os resultados devem ser interpretados dentro do cenário clínico e nutricional único da região. São necessárias mais pesquisas em populações diversas, particularmente em regiões sub-representadas.

***Palavras-chave*:** Acne vulgar. Síndrome metabólico. Resistência à insulina. IMC (índice de massa corporal). Alvo mecanístico do complexo 1 da rapamicina.

Introduction

Acne vulgaris is a multifactorial, chronic inflammatory disorder of the pilosebaceous unit. Pathogenesis involves an interplay of factors, including hyperkeratinization of the follicular ostium, increased sebum production, bacterial colonization (primarily by *Cutibacterium acnes*), inflammation, hormonal influences, diet, and genetic predisposition. While many patients with acne present with normal androgen levels, conditions such as polycystic ovarian syndrome (PCOS) and congenital adrenal hyperplasia may lead to androgen excess and acne exacerbation[1].

Metabolic syndrome is a cluster of interrelated conditions, including insulin resistance, central obesity, dyslipidemia, and hypertension, and has been increasingly associated with chronic inflammatory skin disorders, including acne. Both conditions share common pathophysiological mechanisms, such as chronic inflammation, oxidative stress, and hormonal dysregulation[2].

Metabolic syndrome is driven by insulin resistance in muscle, fat, and liver cells, exacerbated by visceral obesity and elevated free fatty acids. This leads to increased glucose, triglycerides, and very low-density lipoproteins, creating a vicious cycle of insulin oversecretion and lipolysis. Oxidative stress from impaired sebum scavenging mechanisms further links lipid abnormalities to metabolic syndrome. Hormonal imbalances secondary to hyperinsulinism and insulin resistance can trigger androgen-dependent skin conditions such as acne and hirsutism. Inflammatory cytokines such as interleukin-17 and Tumor Necrosis Factor alpha (TNF-α) that are implicated in psoriasis and atopic dermatitis[3] may also possibly contribute to a metabolic syndrome in acne. While some studies have reported a higher prevalence of metabolic syndrome among acne patients[4], the overall evidence remains inconsistent. Notably, the role of dietary factors, particularly high glycemic index diets, in acne remains a subject of ongoing debate, with conflicting findings in the literature. In North-Eastern India, where rice and carbohydrate-rich staples predominate, the possibility of this association warrants a closer investigation. There is a lack of data from this geographically and ethnically distinct region of India, where unique dietary patterns and lifestyle factors may influence the development of acne and its potential systemic associations. Understanding and evaluating the relationship between acne and metabolic syndrome in this context may aid in early diagnosis and provide opportunities for

integrated treatment strategies targeting both cutaneous and systemic aspects of the disease.

Methods

A cross-sectional observational study was conducted over a period of 1 year in the dermatology outpatient department of a tertiary care teaching hospital in North-Eastern India, after receiving approval from the Institutional Ethics Committee. All eligible adult patients presenting with acne vulgaris and/or truncal acne were recruited through consecutive sampling after obtaining written informed consent. The exclusion criteria involved patients who were diagnosed with PCOS, female patients with irregular menstruation history, amenorrhea or oligomenorrhea, hirsutism, associated male pattern baldness, pregnancy, and acne patients who have taken isotretinoin in the last 3 months.

A detailed assessment of the patient's demographic profile, clinical history, and clinical evaluation was done based on a predefined *pro forma*. Dietary practices were assessed using a structured 7-day recall method, wherein participants were asked to report the number of servings per week for common food items such as vegetables, fruits, chicken, pork, beef, and fish. Participants also provided information on the primary type of cooking oil used at home (e.g., refined oil, mustard oil). The recall focused solely on weekly serving frequency and oil type; detailed portion sizes or nutrient quantification were not assessed. No validated dietary assessment tool was used, which is acknowledged as a limitation. Physical activity was similarly evaluated using a 7-day recall approach. Patients were asked to report engagement in moderate-intensity activities such as brisk walking, cycling at a regular pace, gardening, vacuuming, and doubles tennis. Data were recorded in terms of frequency (days per week) and approximate duration (minutes or hours per day), based on patient-reported estimates. Body mass index (BMI) was calculated and graded according to the recommendations of the Asia-pacific task force: underweight (< 18.5 kg/m^2), normal weight (18.5-22.9 kg/m^2), overweight (23.0-24.9 kg/m^2), and obesity class I (25.0-29.9 kg/m^2), and obesity class II (≥ 30.0 kg/m^2).

Severity of acne was calculated using the global acne grading system[5] by a single dermatologist, which involves dividing the face (including the forehead, both cheeks, the nose, and the chin), chest, and back into six specific regions. The severity of lesions in each area is rated on a scale from 0 to 4, where 0 indicates no lesions, 1 represents comedones, 2 denotes papules, 3 signifies pustules, and 4 corresponds to nodules. After assigning scores for all six regions, the total score is calculated, which is then used to classify acne severity as mild (1-18), moderate (19-30), severe (31-38), or very severe (> 39). Assessment of laboratory parameters was done after overnight fasting for 8 h and included measurement of blood sugar, lipid profile (cholesterol, triglycerides, and high-density lipoprotein [HDL]), uric acid, thyroid profile (thyroid-stimulating hormone [TSH]), vitamin D3, testosterone, dehydroepiandrosterone sulfate (DHEAS), estradiol, and insulin.

Insulin resistance was defined using the Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) using the formula: fasting insulin (in micro-units per milliliter) multiplied by fasting glucose (in milligrams per deciliter), then divided by 405. Values exceeding 2.5 were considered to be suggestive of insulin resistance[6].

Metabolic syndrome was diagnosed using the guidelines established by the modified National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III)[7]. The criteria include the presence of any three or more of the following five risk factors:

- Central obesity, indicated by a waist circumference of at least 102 cm for men and 88 cm for women (adjusted for Asian populations to > 90 cm and 80 cm, respectively)
- Triglyceride levels of 150 mg/dL or higher, or the use of medication for elevated triglycerides
- HDL cholesterol levels below 40 mg/dL, or medication for low HDL levels
- A blood pressure of 130/85 mmHg or above, or the use of antihypertensive medication
- A fasting plasma glucose level of 100 mg/dL or higher, or the use of medication to treat diabetes mellitus.

It is important to note that fasting insulin levels are not included in the NCEP-ATP III criteria. Instead, waist circumference is utilized as a surrogate marker, given its strong correlation with insulin resistance[8].

The data were entered in a Microsoft Excel sheet (Microsoft® Excel for Mac Version 16.98 [25060824]) and analyzed using Jamovi software (version 2.6.25.0)[9]. Categorical variables were expressed as absolute frequencies and relative frequencies (percentages), whereas continuous variables were summarized as mean ± standard deviation or median with interquartile range, depending on data distribution. Associations between grades of acne or BMI with categorical variables such as metabolic syndrome and insulin

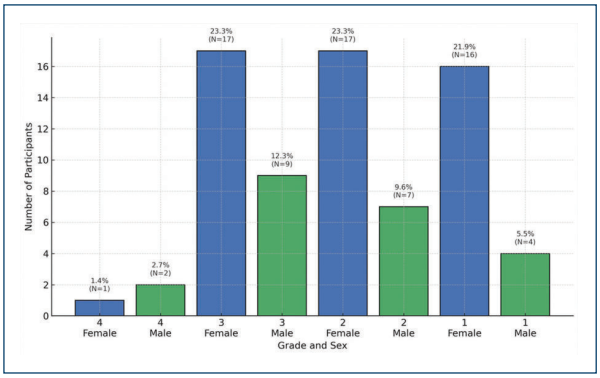

Figure 1. Distribution of acne severity grades by sex.

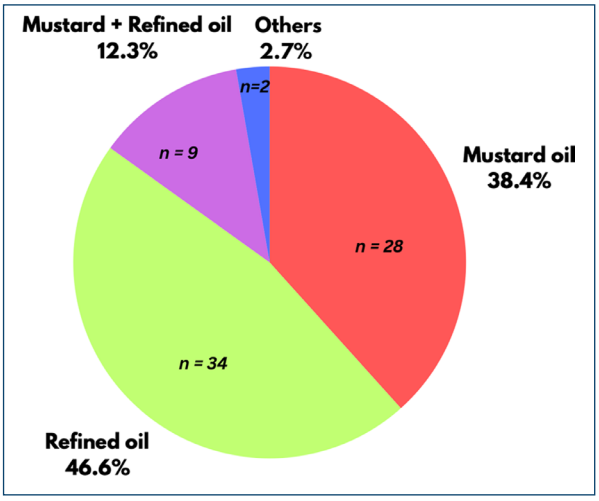

Figure 2. Distribution of cooking oil preferences among study participants.

resistance were assessed using the Mann-Whitney U test. Fisher's exact test was employed to evaluate associations between binary variables due to the small number of positive outcomes. Comparisons of continuous biochemical parameters across acne severity grades were performed using the Kruskal-Wallis test. While logistic and ordinal regression models were considered to explore adjusted associations, they were not performed due to the limited number of outcome events. A $p < 0.01$ was considered statistically significant.

Results

A total of 73 adult patients were included in the study. The patients ranged from 18 to 35 years with a median age of 21 years (interquartile range: 19-25 years) and a mean age of 22.2 ± 3.85. Approximately 70% (n = 51) of the patients were female, with a M:F ratio of 0.43. The majority (82.2%, n = 60) of patients belonged to an urban background.

Acne vulgaris was seen in 50.7% (n = 37), followed by 37% (n = 27) having both acne vulgaris and truncal acne, and the remaining 12.3% (n = 09) had isolated truncal acne. Out of all, the majority (35.6%, n = 26) had a severe grade of acne (Fig. 1). The duration of the disease ranged from 1 month to 15 years, with a median duration of 3 years (interquartile range: 2-5 years).

A positive family history of chronic non-communicable diseases (including diabetes mellitus and hypertension) was found in 39.7% (n = 29). Furthermore, 21.9% (n = 16) and 11% (n = 8) patients gave a history of chronic alcohol consumption and smoking, respectively.Almost 50.7% (n = 37) of patients gave a history of consumption of home-cooked food, out of which 54.8% (n = 40) had three servings and 43.8% (n = 32) had at least two servings. The majority of patients had vegetables on all days of the week with occasional servings of non-vegetarian meals (Table 1). Refined oil and mustard oil were commonly used for home-based cooking (Fig. 2).

Mean moderate physical activity was 1.27 days/week and 11.37 min spent/day (Table 2).

Anthropometry revealed 35.29% (n = 18) of females and 13.63% (n = 3) of males had a waist circumference of ≥ 80 cm and ≥ 90 cm, respectively. Furthermore, 12.32% (n = 9) of patients had a blood pressure of ≥ 130/85 mmHg (Table 2).

The median BMI was 20.93 kg/m^2 (interquartile range: 19.27-23.99 kg/m^2). Among female participants (n = 51), 7 (13.7%) were underweight, 27 (52.9%) had normal weight, 6 (11.8%) were overweight, 9 (17.6%) were classified as Obesity Class I, and 2 (3.9%) as Obesity Class II. Among males (n = 22), 3 (13.6%) were underweight, 13 (59.1%) had normal weight, 2 (9.1%) were overweight, and 4 (18.2%) were classified as Obesity Class I, with none in Obesity Class II. Overall, 8 participants (11.0%) were overweight and 15 (20.5%) were obese, resulting in a combined prevalence of 31.5% with elevated BMI.

The biochemical profile of participants was comprehensively evaluated across acne severity grades. No consistent or clinically meaningful differences were observed in serum uric acid, TSH, DHEAS, insulin, fasting blood glucose, total cholesterol, triglycerides, HDL, estradiol, or testosterone levels (all $p > 0.01$, Kruskal-Wallis test). Only serum vitamin D levels approached statistical significance ($p = 0.011$, Kruskal-Wallis test), though this did not meet the predefined

Table 1. Distribution of weekly servings of major food groups by sex

Servings	Sex	n	Mean	Standard deviation	Minimum	Maximum
Vegetables	Female	51	6.176	1.466	2	7
	Male	22	5.636	1.891	1	7
Fruits	Female	51	3.176	2.260	0	7
	Male	22	2.591	1.894	0	7
Chicken	Female	51	2.157	1.901	0	7
	Male	22	2.136	1.521	0	6
Pork	Female	51	1.176	1.852	0	7
	Male	22	0.227	0.528	0	2
Beef	Female	51	1.078	1.440	0	7
	Male	22	0.909	1.688	0	7
Fish	Female	51	1.588	1.663	0	7
	Male	22	1.682	1.729	0	7

threshold of $p < 0.01$ (Table 3). When categorized using clinical reference standards, vitamin D deficiency (< 20 ng/mL) was observed in 52 participants (71.2%), insufficiency (20-29 ng/mL) in 18 participants (24.7%), and sufficiency (≥ 30 ng/mL) in only 3 participants (4.1%). No cases of vitamin D toxicity were noted.

According to the HOMA-IR criteria, 6.85% (n = 5) of patients had insulin resistance, out of which three were female and had a severe grade of acne. In line with the NCEP-ATP III criteria, 5.47% (n = 4) of patients had metabolic syndrome, out of which half had insulin resistance. However, no statistically significant association was found between acne severity and either metabolic syndrome or insulin resistance (Table 4). A statistically significant association was observed between BMI and the presence of metabolic syndrome ($p = 0.007$, Mann-Whitney U test), with higher BMI values noted among participants with metabolic syndrome. In contrast, the association between BMI and insulin resistance did not reach the predefined threshold for statistical significance ($p = 0.026$), though a trend toward higher BMI in insulin-resistant individuals was noted.

Discussion

Acne vulgaris and metabolic syndrome may share overlapping pathogenic mechanisms, including chronic inflammation, oxidative stress, hormonal dysregulation, and nutrient-sensing pathway disturbances such as elevated mechanistic target of rapamycin complex 1 (mTORC1) activity. Increased mTORC1 signaling, observed in acne-prone skin, has been linked to insulin resistance and obesity, underscoring the complex interplay between dermatological and metabolic pathways[10].

In our study, a total of 73 patients were included. 70% of our patients were female, which was akin to other studies showing a female preponderance[11]. The mean age of our patients was 22.2 ± 3.85, which is similar to another study by Chandak et al., where the mean age was 23.43 ± 3.99 years with predominantly mild to moderate grades of acne; however, in our study, the majority of patients had severe acne (grades 3 and 4)[12]. The predominance of severe acne in this study population may be partly shaped by the nature of a tertiary care setting, where individuals with persistent, distressing, or treatment-refractory acne are more inclined to seek specialized help either through formal referral or personal initiative. In the context of North-Eastern India, this could also reflect broader patterns, where access to early dermatological care is uneven, over-the-counter remedies are commonly used, and visible skin conditions carry a social weight that quietly urges people to seek help only when the burden becomes too much. These are possibilities that merit deeper, community-rooted inquiry.

According to the seven-day recall method, half of our study participants gave a history of consumption of home-cooked meals with a predominant component of vegetables and chicken. Refined oil and mustard oil

Table 2. Distribution of physical activity and anthropometric variables by sex

Variable	Sex	n	Mean	Standard deviation	Minimum	Maximum
Moderate physical activity (minutes/day)	Female	51	3.333	10.280	0	60
	Male	22	30.000	50.710	0	180
Moderate physical activity (days/week)	Female	51	0.765	1.830	0	7
	Male	22	2.455	3.080	0	7
10 min walk (days/week)	Female	51	4.157	3.100	0	7
	Male	22	5.182	2.920	0	7
Walks (minutes/day)	Female	51	36.275	47.460	0	180
	Male	22	55.682	70.670	0	240
Leisure/sitting in a week (hours/day)	Female	51	5.784	2.370	1	12
	Male	22	6.364	2.340	1	12
Waist circumference (in centimetres)	Female	51	80.200	10.690	63	116
	Male	22	78.700	9.320	63	93
Hip circumference (in centimetres)	Female	51	90.700	8.250	73	121
	Male	22	91.400	8.160	73	104
Weight (in kilograms)	Female	51	53.500	10.930	39	99
	Male	22	59.500	9.700	41	79
Height (in centimetres)	Female	51	155.100	5.460	143	168
	Male	22	167.300	5.900	149	178
Systolic blood pressure (mmHg)	Female	51	111.800	9.260	90	138
	Male	22	121.100	16.130	100	180
Diastolic blood pressure (mmHg)	Female	51	73.500	7.490	60	90
	Male	22	80.400	10.320	60	100

were the most commonly used oils for the preparation of food. According to a study by Bansal et al., 23.33% of females gave a history of oily food intake regularly[13]. A high glycemic diet may trigger acne through disrupted nutrient signaling, leading to hyperkeratosis, hyper-seborrhea, and mTORC1 activation, alongside elevated androgen levels[14]. The mean waist circumference in our patients was 79.8 cm, which was comparable to another study by Kaya et al.[15]. Acne in industrialized countries signals aberrant nutrient-driven mTORC1 activation, linked to chronic diseases. Therefore, dermatologists should leverage dietary interventions to mitigate acne and prevent mTORC1-driven conditions[16,17].

The mean moderate physical activity duration in our study participants was approximately 80 min/week, which is inconsistent with the recommended World Health Organization 2020 guidelines on physical activity and sedentary behavior[18]. In the present study, the median BMI of participants was 20.93 kg/m^2 (interquartile range: 19.27-23.99 kg/m^2), with 11.0% classified as overweight and 20.5% as obese, reflecting a combined prevalence of elevated BMI in 31.5% among the participants. Importantly, BMI demonstrated a statistically significant association with metabolic syndrome ($p = 0.007$) and a suggestive trend with insulin resistance ($p = 0.026$), reinforcing the metabolic implications of higher BMI even in a young population. In our study, serum biochemical parameters, including uric acid, TSH, testosterone, estradiol, DHEAS, lipid profile, fasting glucose, and insulin, were largely within normal physiological ranges across both sexes. Notably, no participants demonstrated thyroid dysfunction, suggesting a predominantly euthyroid status in contrast to findings by Bungau et al.[19], where hypothyroidism or

Table 3. Distribution of biochemical parameters by sex with corresponding p-values (Kruskal-Wallis test)

Biochemical parameter	Sex	n	Mean	Standard deviation	Minimum	Maximum	p
Uric acid (mg/dL)	Female	51	4.939	0.913	2.700	7.300	0.727
	Male	22	6.473	1.669	2.900	9.500	
TSH (mU/mL)	Female	51	2.115	1.231	0.790	6.870	0.693
	Male	22	1.668	0.921	0.040	4.530	
Vit. D (ng/mL)	Female	51	17.160	5.382	7.700	34.210	0.011
	Male	22	18.153	6.637	10.600	34.210	
Estradiol (pg/mL)	Female	51	129.843	96.615	28.000	506.000	0.778
	Male	22	53.364	23.114	20.000	123.000	
Testosterone (ng/dL)	Female	51	0.974	1.467	0.130	6.790	0.154
	Male	22	4.183	2.747	0.190	7.870	
DHEAS (mcg/dL)	Female	51	202.625	86.982	54.900	404.900	0.744
	Male	22	271.777	171.668	77.300	832.400	
Total cholesterol (mg/dL)	Female	51	141.588	32.344	76.000	231.000	0.152
	Male	22	133.455	25.069	73.000	176.000	
Triglycerides (mg/dL)	Female	51	77.980	27.335	37.000	170.000	0.989
	Male	22	102.818	40.086	43.000	169.000	
HDL (mg/dL)	Female	51	49.392	8.300	32.000	69.000	0.099
	Male	22	42.773	9.938	27.000	62.000	
FBS (mg/dL)	Female	51	82.588	7.052	70.000	110.000	0.769
	Male	22	83.000	8.608	61.000	101.000	
Insulin (mIU/L)	Female	51	5.749	2.891	1.710	14.920	0.628
	Male	22	5.642	0.913	1.260	7.300	
HOMA-IR score	Female	51	1.184	1.669	0.312	9.500	-
	Male	22	1.208	1.231	0.236	6.870	

TSH: thyroid-stimulating hormone; DHEAS: dehydroepiandrosterone sulphate; HDL: high-density lipoprotein; FBS: fasting blood sugar; HOMA-IR: homeostasis model assessment of insulin resistance.

autoimmune thyroiditis was frequently observed among acne patients. However, vitamin D levels were generally low in our study population, with only three participants falling within the normal range. This aligns with a recent meta-analysis by Hasamoh et al.[20], which found significantly lower serum vitamin D levels in acne patients compared to healthy controls and a negative correlation between vitamin D levels and acne severity. While these findings suggest a potential role of vitamin D in acne pathogenesis, our results highlight the importance of interpreting laboratory data within a broader clinical and contextual framework, especially in populations where baseline hypovitaminosis D may be widespread due to lifestyle or geographic factors, rather than assuming direct causality.

As per the HOMA-IR criteria and NCEP-ATP III, 7% patients had insulin resistance and 5.47% had metabolic syndrome, respectively; however, there was no significant association with acne severity. It was albeit not in consonance with other studies, which showed a statistically significant association between acne, metabolic syndrome, and/or insulin resistance[21-24]. However, this may be attributed to the overall low prevalence of metabolic syndrome in the north eastern part of India, which is supported by a study by Meher and Sahoo, revealing the states of Meghalaya and Assam

Table 4. Statistical associations between clinical variables and metabolic outcomes

Association tested	Statistical test	p
Grade versus metabolic syndrome	Mann-Whitney U	0.069
Grade versus insulin resistance	Mann-Whitney U	0.305
BMI versus metabolic syndrome	Mann-Whitney U	0.007
BMI versus insulin resistance	Mann-Whitney U	0.026
Sex versus metabolic syndrome	Fisher's Exact	0.579
Sex versus insulin resistance	Fisher's Exact	0.634

BMI: body mass index.

to have the lowest prevalence of metabolic syndrome in the case of females (0.5%) and males (0.4%) respectively. In the same study, overall north-eastern India showed a prevalence of metabolic syndrome to be 0.7% in females and 0.5% in males[25].

Several limitations must be acknowledged when interpreting our findings. First, the heterogeneous distribution of acne severity among participants may have diluted potential associations, especially in the absence of a control group. Second, the dietary data were collected using a 7-day recall period without a validated assessment tool, introducing potential recall bias and limiting the precision of dietary intake estimates. Third, the lack of age- and sex-matched healthy controls restricts our ability to draw definitive comparisons. These factors, combined with the cross-sectional design and relatively small sample size, suggest that our findings should be interpreted with caution and not extrapolated beyond the studied population. Future longitudinal studies with standardized dietary assessments and appropriate control groups are warranted to provide deeper insights into the metabolic underpinnings of acne, especially within diverse regional populations such as those in North-East India.

Conclusion

In this study from a tertiary care centre in North-Eastern India, no significant association was found between acne severity and metabolic syndrome or insulin resistance. Although over 30% of participants were overweight or obese, and vitamin D deficiency was widespread, these factors did not show a consistent association with acne severity. These findings highlight the multifactorial nature of acne, shaped by intricate metabolic and nutritional influences that may vary across populations. Given the study's cross-sectional design, modest sample size, and absence of validated dietary tools or matched controls, the results should be interpreted within the unique clinical and nutritional landscape of North-Eastern India, without extrapolation to broader populations. Further longitudinal research is warranted to unravel these associations in more depth, especially in under-represented regions.

What does the study add?

This study contributes to evaluating the relationship between acne vulgaris and metabolic syndrome in patients from North-Eastern India, a population largely under-represented in dermatologic-metabolic research. Even though many participants presented with severe acne, the study did not identify a meaningful link with metabolic syndrome or insulin resistance. These findings challenge assumptions of universal dermato-metabolic linkage and emphasize the influence of regional variables, including diet, physical activity, and metabolic profile, on systemic inflammatory pathways in acne, along with underscoring the importance of conducting broader, multi-regional studies across ethnically and culturally diverse populations to better understand the potential metabolic underpinnings of acne.

Funding

None.

Conflicts of interest

None.

Ethical considerations

Protection of humans and animals. The authors declare that the procedures followed complied

with the ethical standards of the responsible human experimentation committee and adhered to the World Medical Association and the Declaration of Helsinki. The procedures were approved by the institutional Ethics Committee.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Sutaria AH, Masood S, Saleh HM, Schlessinger J. Acne vulgaris. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2025. Available from: https://www.ncbi.nlm.nih.gov/books/nbk459173 [Last accessed on 2025 Jun 22].
2. Bungau AF, Radu AF, Bungau SG, Vesa CM, Tit DM, Endres LM. Oxidative stress and metabolic syndrome in acne vulgaris: pathogenetic connections and potential role of dietary supplements and phytochemicals. Biomed Pharmacother. 2023;164:115003.
3. Adibi N, Robati RM. Skin and metabolic syndrome: a review of the possible associations. J Res Med Sci. 2021;26:16.
4. Hu Y, Zhu Y, Lian N, Chen M, Bartke A, Yuan R. Metabolic syndrome and skin diseases. Front Endocrinol (Lausanne). 2019;10:788.
5. Bae IH, Kwak JH, Na CH, Kim MS, Shin BS, Choi H. A comprehensive review of the acne grading scale in 2023. Ann Dermatol. 2024;36:65-73.
6. Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC. Homeostasis model assessment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. Diabetologia. 1985;28:412-9.
7. Huang PL. A comprehensive definition for metabolic syndrome. Dis Model Mech. 2009;2:231-7.
8. The Jamovi Project. Jamovi (Version 2.6) [Computer Software]; 2025. Available from: https://www.jamovi.org
9. Ross R, Neeland IJ, Yamashita S, Shai I, Seidell J, Magni P, et al. Waist circumference as a vital sign in clinical practice: a consensus statement from the IAS and ICCR working group on visceral obesity. Nat Rev Endocrinol. 2020;16:177-89.
10. Fatima F, Das A, Kumar P, Datta D. Skin and metabolic syndrome: an evidence based comprehensive review. Indian J Dermatol. 2021;66:302-7.
11. Hasrat NH, Al-Yassen AQ. The relationship between acne vulgaris and insulin resistance. Cureus. 2023;15:e34241.
12. Chandak S, Singh A, Madke B, Jawade S, Khandelwal R. Acne vulgaris and metabolic syndrome: a possible association. Cureus. 2022;14:e24750.
13. Bansal P, Sardana K, Vats G, Sharma L, Garga UC, Khurana A. A prospective study examining trigger factors and hormonal abnormalities in adult female acne. Indian Dermatol Online J. 2020;4:544-50.
14. Romańska-Gocka K, Woźniak M, Kaczmarek-Skamira E, Zegarska B. The possible role of diet in the pathogenesis of adult female acne. Postepy Dermatol Alergol. 2016;33:416-20.
15. Kaya F, Eryılmaz MA, Pekgör O, Külahçı E. Evaluation of the relationship between insulin resistance and visceral adiposity index in patients with acne vulgaris. Turk J Med Sci. 2022;52:477-83.
16. Melnik BC, John SM, Plewig G. Acne: risk indicator for increased body mass index and insulin resistance. Acta Derm Venereol. 2013;93:644-9.
17. Melnik BC. Linking diet to acne metabolomics, inflammation, and comedogenesis: an update. Clin Cosmet Investig Dermatol. 2015;8:371-88.
18. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World health organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020;54:1451-62.
19. Bungau AF, Tit DM, Bungau SG, Vesa CM, Radu AF, Marin RC, et al. Exploring the metabolic and endocrine preconditioning associated with thyroid disorders: risk assessment and association with acne severity. Int J Mol Sci. 2024;25:721.
20. Hasamoh Y, Thadanipon K, Juntongjin P. Association between vitamin D level and acne, and correlation with disease severity: a meta-analysis. Dermatology. 2022;238:404-11.
21. Nagpal M, De D, Handa S, Pal A, Sachdeva N. Insulin resistance and metabolic syndrome in young men with acne. JAMA Dermatol. 2016;152:399-404.
22. Gruszczyńska M, Sadowska-Przytocka A, Szybiak W, Wíckowska B, Lacka K. Insulin resistance in patients with acne vulgaris. Biomedicines. 2023;11:2294.
23. Andreadi A, Muscoli S, Tajmir R, Meloni M, Minasi A, Muscoli C, et al. Insulin resistance and acne: the role of metformin as alternative therapy in men. Pharmaceuticals (Basel). 2022;16:27.
24. Solanki AD, Solanki DK, Banker KK, Rangnani TC, Patel NM, Modi KR. Role of insulin resistance in patients of acne vulgaris and hirsutism in the western part of India- a cross-sectional study. Indian Dermatol Online J. 2023;14:38-43.
25. Meher T, Sahoo H. The epidemiological profile of metabolic syndrome in Indian population: a comparative study between men and women. Clin Epidemiol Glob Health. 2020;8:1047-52.