



Study of prevalence of metabolic syndrome in patients of acne vulgaris: a hospital based case control study

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Abstract. Background: Acne vulgaris is a common chronic inflammatory skin condition affecting the pilosebaceous units, leading to lesions such as comedones, nodules, and cysts. Although it is most prevalent during adolescence, it affects individuals across all age groups, causing both physical discomfort and psychological distress. Recent research has suggested potential links between acne vulgaris and systemic metabolic disorders, particularly metabolic syndrome.

Material and Methods: This case control study was conducted at the Department of Dermatology, Index Medical College Hospital, Indore, Madhya Pradesh, India. A total of 100 patients aged 18-45 years, clinically diagnosed with acne vulgaris, and 100 age- and sex-matched controls were selected. Detailed history, medical examination, and acne grading (1 to 4) were performed. Laboratory tests included fasting blood sugar, fasting lipid profile (triglycerides, HDL-C), blood pressure (BP) measurement, and waist circumference (WC).

Results: The study population had a mean age of 30.8 years, with a slightly higher female-to-male ratio. A moderate positive correlation between acne severity and triglyceride levels and waist circumference was observed, with both being statistically significant. As acne severity increased, triglyceride levels and waist circumference also tended to increase, indicating a potential association with metabolic syndrome. The study also found that metabolic parameters, rather than demographic or acne-specific factors, were stronger predictors of metabolic syndrome in acne patients.

Conclusion: The study demonstrates a strong statistical link between acne vulgaris and metabolic syndrome prevalence. Significant positive correlations between acne severity and metabolic parameters like triglycerides and waist circumference highlight the importance of monitoring metabolic health in acne patients. These findings suggest that managing metabolic health may reduce the risk of metabolic syndrome in individuals with acne vulgaris, improving overall patient outcomes.

Keywords: Acne, Dyslipidemia, Insulin resistance, Hypertension, Central obesity

Introduction

Acne vulgaris is a prevalent chronic and inflammatory skin condition that impacts the pilosebaceous units, leading to a spectrum of lesions ranging from comedones to nodules and cysts. [1] A complex web of genetic, hormonal, immunological, and environmental variables have a role in the pathophysiology of Acne vulgaris. [2] The distribution of lesions varies, with the face being the most commonly affected area,



followed by the chest and back.

The predominant method of diagnosing acne vulgaris is clinical, relying on the distribution and distinctive look of lesions. A number of grading schemes, like the Pillsbury scale and the Global Acne Grading System (GAGS), can be used to determine how severe acne is. [3]

New research has revealed possible links between the condition and systemic metabolic disorders, especially metabolic syndrome. Metabolic syndrome is a collection of metabolic disorders that raise the risk of type 2 diabetes mellitus and cardiovascular disease. These disorders include insulin resistance, central obesity, dyslipidemia, and hypertension. [4]

Inflammation is a major factor in the development of lesions in acne vulgaris, helping to create inflammatory papules and pustules. In the same way, increased levels of pro-inflammatory cytokines and inflammation in adipose tissue led to insulin resistance and cardiovascular problems in those with metabolic syndrome. [5]

A characteristic of the metabolic syndrome, insulin resistance arises when target tissues become less sensitive to insulin, which causes compensatory hyperinsulinemia. [6]

Interestingly, the pathophysiology of acne vulgaris has been linked to insulin and insulin-like growth factor-1(IGF-1). [7]

Acne vulgaris is mostly caused by hormonal abnormalities, especially when there is an excess of androgen. Androgens have a role in the development of acne lesions by increasing follicular hyperkeratinization and stimulating sebaceous gland activity. Similarly, insulin resistance causes the ovaries and adrenal glands to produce more androgen, which is why hyperandrogenism is a major characteristic of metabolic syndrome. [4]

The aim of the study was to investigate prevalence of metabolic syndrome in patients of acne vulgaris.

Material and methods

A case control study was conducted over an 18-month period from Sep 2022 to March 2024 at the Dermatology Department of Index Medical College and Hospital, Indore. The study received approval from the Institutional Ethics Committee (IMCHRC/IEC/2022/53 dated 22.10.2022). Participants included all consenting patients aged between 18 and 45 years, of either gender, attending the Skin & VD OPD with clinically diagnosed acne vulgaris. Exclusion criteria included pregnant or breastfeeding women, patients on isotretinoin, oral contraceptive pills, or hormonal therapy, and those with known diabetes, hypertension, or dyslipidemia.

Patients satisfying the criteria of inclusion were randomly selected and Informed consent was obtained from all patients after providing sufficient information about the study. Acne severity was clinically assessed and graded into four categories: Grade 1 (mostly comedones), Grade 2 (predominantly papular with few pustules), Grade 3 (predominantly pustular), and Grade 4 (nodulocystic). Biochemical evaluations were



performed, which included fasting blood sugar, lipid profile (triglycerides and HDL-C), blood pressure (BP) measurement, and waist circumference (WC) assessment.

Metabolic syndrome was evaluated based on the American Heart Association (AHA) guidelines, requiring at least three of the following criteria: fasting glucose ≥ 100 mg/dL (or on hyperglycemia therapy), blood pressure $\geq 130/85$ mm Hg (or on antihypertensive therapy), triglycerides ≥ 150 mg/dL (or on hypertriglyceridemia therapy), HDL-C < 40 mg/dL in men or < 50 mg/dL in women (or on reduced HDL-C therapy), and waist circumference ≥ 102 cm (40 inches) in men or ≥ 88 cm (35 inches) in women (or specific measurements for Asian Americans).

Statistical Analysis

The collected data were entered and compiled using Microsoft Excel 2010, and statistical analysis was carried out using IBM SPSS Statistics version 22.0. Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequencies and percentages. To compare proportions between groups, the Chi-square test was employed. The unpaired t-test was used to compare the means of continuous variables between two independent groups. A p-value < 0.05 was considered statistically significant. Pearson's correlation coefficient was applied to assess the strength and direction of the linear relationship between continuous variables. Additionally, binary logistic regression analysis was performed to determine independent predictors of metabolic syndrome among the study participants. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs) to quantify the strength of association between predictors and the presence of metabolic syndrome.

Results

The study included 200 participants, divided equally between 100 acne vulgaris (AV) patients and 100 controls, with ages ranging from 18 to 45 years and a mean age of 30.8 years. Among the participants, there were 107 females and 93 males. The average duration of acne was about 6 months, and acne grades varied from 0 (controls) to 4.

Biochemical parameters revealed that fasting blood sugar (FBS) ranged from 63.15 to 135.61 mg/dL, with a mean of 100.84. Triglyceride levels ranged from 12.95 to 289.19 mg/dL, with a mean of 148.23. HDL-C levels varied from 10.19 to 68.57 mg/dL, with a mean of 44.33. Blood pressure measurements ranged from 86.48 to 164.48 mmHg, with an average of 120.81, and waist circumference ranged from 63.01 to 117.94 cm, with a mean of 90.24. The study found that FBS distribution was similar across both acne vulgaris (AV) patients and controls, with no significant difference [Figure 1]. Triglyceride levels were slightly higher among AV patients, indicating a potential link to metabolic syndrome (MetS). HDL cholesterol levels overlapped between groups, with no major difference. Blood pressure was slightly higher in AV patients, suggesting a possible connection to MetS. Waist circumference was notably larger in AV patients,



indicating central obesity as a MetS marker. [Table 1]
Chi-Square analysis ($p \approx 0.005$) confirmed a strong association between AV and MetS, with 38 AV patients and 20 controls meeting MetS criteria [Table 1].

Table 1: Comparative Distribution of Demographic and Biochemical Parameters Between Cases and Controls (N = 200)

PARAMETER	CASES (N=100)	CONTROL (N=100)
AGE DISTRIBUTION		
<20 YEARS	6	9
21-30 YEARS	42	37
31-40 YEARS	43	46
41-50 YEARS	9	8
FASTING BLOOD SUGAR LEVELS (mg/dL)		
<60	4	0
61-70	0	17
71-80	0	23
81-90	23	12
91-100	46	26
101-110	10	6
111-120	8	0
121-130	1	0
>130	8	16
TRIGLYCERIDE LEVELS (mg/dL)		
0-50	0	2
51-100	31	29
101-150	35	35
151-200	23	17
201-250	3	9
>250	8	8
HDL CHOLESTROL LEVELS (mg/dL)		
>20-30	4	5
>30-40	46	30
>40-50	42	37
>50-60	4	21
>60-70	4	7
WAIST CIRCUMFERENCE (cm)		
≤70	4	4
71-80	11	52
81-90	65	21
91-100	16	18
>101	4	5
METABOLIC SYNDROME		
Present	40	20
Absent	60	80

Triglycerides and waist circumference showed moderate positive correlations with acne severity, indicating a link to MetS. Additionally, acne severity and triglyceride levels were positively associated, highlighting potential MetS risks. Age was near-



significantly associated, while sex, acne duration, and acne grade did not significantly predict MetS. These findings suggest metabolic parameters, rather than demographic factors or acne-specific traits, are more predictive of MetS in acne patients [Table 2].

Table 2 displays the coefficients of significant predictors of metabolic syndrome among acne patients, derived from the logistic regression analysis

Parameter	Coefficient	OR	95% CI for OR
Fasting Blood Sugar (mg/dL)	0.1675	1.1822	1.0376 – 1.3465
Triglycerides (mg/dL)	0.0597	1.0615	0.9666 – 1.1656
HDL-C (mg/dL)	-0.1686	0.8449	0.7301 – 0.9778
Blood Pressure (mmHg)	0.1584	1.1716	1.0414 – 1.3171
Waist Circumference (cm)	0.2215	1.2479	1.0879 – 1.4313

Discussion

There were 100 acne vulgaris sufferers and 100 controls in our study. The patients in our study ranged in age from 18 to 45 years, with a mean age of 30.8. The ratio of females to males were slightly higher. The typical length of acne was six months. The results showed a high correlation between acne and metabolic syndrome, with an odds ratio of 2.45. Particularly those with acne are more likely to have elevated triglyceride levels, and there was also a nearly significant correlation seen with age. There doesn't seem to be a strong correlation between the sex, severity, or duration of acne and the metabolic syndrome.

The review of the literature shed light on the relationship between metabolic syndrome (MetS) and acne vulgaris from a number of angles. Significant relationships between the severity of acne and elements of the metabolic syndrome (MetS) have been shown by Purnachandra et al. (2021) [8] and Leelambika C et al. (2019) [9], who focused in particular on lipid profile markers like high density lipoprotein (HDL) levels.

Furthermore, a higher prevalence of metabolic abnormalities was observed by Sinikumpu et al. (2023) among male acne patients, indicating a possible gender-specific link. In line with the findings of Purnachandra et al. (2021) [8], chi-square and Fisher's exact tests revealed a significantly greater prevalence of MetS among acne vulgaris patients compared to controls. This statistical correlation raises the possibility of a shared underlying mechanism perhaps involving hormonal imbalances or systemic inflammation that connects acne vulgaris and MetS.

The association between the severity of acne and metabolic markers were further clarified by correlation analysis. Our findings supported the findings of Leelambika C et al. (2019) [9] by showing moderately positive relationships between waist circumference and triglycerides and acne severity. These associations support the idea that acne vulgaris and metabolic syndrome share a pathophysiological relationship, indicating that there is a proportional increase in metabolic syndrome characteristics as acne severity increases.

Significant predictors of MetS were found among acne patients using logistic



regression analysis. Additionally, a moderate AUC value was obtained via ROC curve analysis, which assessed the acne severity's capacity to predict the presence of MetS.

Our study's findings regarding the relationship between metabolic parameters and acne severity are consistent with the molecular insights presented by Akdağ et al. (2024) [10], who linked the pathophysiology of MetS and acne vulgaris to the mTOR pathway and microRNAs related to metabolic signalling. According to our research, changes in triglycerides and waist circumference, two markers of metabolic dysregulation, may have a role in the onset and severity of acne vulgaris.

Our logistic regression analysis revealed several significant predictors of MetS, including waist circumference, triglycerides, and fasting blood sugar. These findings are consistent with those of Hu et al. (2019) [11], who highlighted the significance of comprehending shared mechanisms, such as insulin signalling and chronic inflammation, in the relationship between MetS and skin diseases.

Moreover, the ROC curve analysis indicates that acne severity has a moderate potential to predict MetS. This shows that evaluating acne severity in conjunction with metabolic indicators could improve MetS early identification and risk stratification in clinical practice. This is in line with the suggestions made by Morey A et al. (2020) [12].

Our study's findings about the relationships between metabolic parameters and acne severity are consistent with those of Mohammed GF et al. (2023) [13], who found that individuals with acne had different lipid profiles and hormone levels.

Furthermore, Hasrat NH et al. (2023) [14] revealed a significant correlation between acne vulgaris and insulin resistance, are consistent with the association between acne severity and metabolic syndrome components. This suggests that insulin resistance may play a role in the aetiology and severity of acne.

Furthermore, the findings reached by Akinboro AO et al. (2018) [15], who examined the cutaneous correlates of MetS and its components, are consistent with the significant predictors of metabolic syndrome found in our logistic regression analysis, such as fasting blood sugar, triglycerides, and waist circumference.

In contrast to our research, a study by Chandak et al. (2022) [4] found an association with metabolic syndrome and other indicators but did not find a correlation between acne and hypertension or dyslipidemia. Research by Balta I et al. (2015) [16] and Nagpal M et al. (2016) [17] did not find a statistically significant difference between the two groups' HDL levels. Remarkably, obesity was found to protect against acne in a study by Snast I et al. (2019) [18]. This protective effect was attributed to increased aromatase activity and reduction of 5-alpha-reductase 2 activity.

Our study's findings about the relationships between metabolic parameters and acne severity are consistent with Melnik B et al. (2012) [19] discussion of the role of diet in acne development. Melnik B et al. (2012) [19] emphasized the probable link between nutrition, especially the Western diet, and worsening acne as well as the therapeutic advantages of low-glycemic load diets. By showing actual links between the severity of acne and metabolic indicators like triglycerides and waist circumference, our study expands on previous discoveries by raising the possibility that dietary factors may be involved in both the severity of acne and metabolic abnormalities.



Furthermore, the significant association between acne vulgaris and metabolic syndrome components resonates with the findings of Khan et al. (2023) [20], who assessed the psychosocial impact of acne vulgaris in Pakistani adolescents. Although their study focused on the psychosocial aspects of acne, our findings corroborate the notion that acne vulgaris may have broader systemic implications, including metabolic disturbances. This emphasizes how crucial it is to take into account acne vulgaris overall effects on a patient's health and wellbeing.

Furthermore, our logistic regression analysis's strong metabolic syndrome predictors align with the results of Arif A et al.'s (2023) [21] investigation of the prevalence of metabolic syndrome in individuals with chronic plaque psoriasis. Although their study focused on psoriasis patients, our findings extend their conclusions by identifying similar predictors of metabolic syndrome in acne patients, suggesting common underlying mechanisms across different dermatological conditions.

A major limitation of this study is the cross-sectional design, which limits the ability to establish causal relationships between acne vulgaris and metabolic syndrome. Additionally, the relatively small sample size and the study's single-center design may affect the generalizability of the findings.

In conclusion, by clarifying connections and predictors of metabolic syndrome among acne patients, this work advances knowledge of the intricate interaction between acne vulgaris and metabolic syndrome. By correlating our findings with existing literature, we provide empirical evidence supporting the association between acne vulgaris and metabolic disturbances.

Conclusion

The study findings confirm a strong statistical association between acne vulgaris and the prevalence of metabolic syndrome. Both Chi-square and Fisher's exact tests demonstrate a significantly higher occurrence of metabolic syndrome among cases compared to controls, suggesting a shared pathophysiological link between these two conditions. We observed moderate positive correlations between acne severity and metabolic parameters such as triglycerides and waist circumference. Logistic regression analysis identifies significant predictors of metabolic syndrome among cases, with metabolic parameters such as Fasting blood sugar, Triglycerides, HDL-C, blood pressure, and waist circumference emerging as key predictors. Our findings provide insight into the relationships and factors that predict metabolic syndrome in acne patients, which can help to improve patient outcomes and lower the chance of metabolic problems.

To sum up, our study helps to close the knowledge gap between metabolic medicine and dermatology, opening the door to more thorough and individualized patient care.



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