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Original Article

A prospective observational study on the correlation between hormonal profiles and acne severity in women with adult-onset acne.

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Abstract

Background:

Adult-onset acne (AOA) is increasingly prevalent among women and is often refractory to conventional therapy. Hormonal fluctuations, hyperandrogenemia, and metabolic disturbances are recognized contributors, yet the correlation between hormonal profiles and acne severity remains under-defined in Indian women.

Objectives:

To evaluate the relationship between serum hormonal parameters and the severity of acne in women presenting with adult-onset acne.

Methods:

A prospective observational study was conducted among 100 women aged 18–40 years with clinically diagnosed AOA attending a tertiary dermatology OPD. Detailed clinical assessment, menstrual and family history, and Global Acne Grading System (GAGS) scoring were performed. Fasting serum levels of total and free testosterone, DHEA-S, SHBG, LH, FSH, prolactin, TSH, 17-hydroxyprogesterone, and fasting insulin (HOMA-IR) were estimated. Correlations between hormonal parameters and acne severity were analyzed using Spearman's rank test and multivariate logistic regression.

Results:

The mean age of participants was 26.8 ± 4.9 years. Menstrual irregularity and PCOS were observed in 38% and 41% respectively. Based on GAGS, 28% had mild, 46% moderate, and 26% severe acne. Elevated free testosterone (34%), total testosterone (29%), and reduced SHBG (26%) were the most frequent hormonal abnormalities. Acne severity correlated positively with free testosterone ($\rho = 0.41$, $p < 0.001$), total testosterone ($\rho = 0.32$, $p = 0.002$), DHEA-S ($\rho = 0.29$, $p = 0.004$), and LH/FSH ratio ($\rho = 0.24$, $p = 0.016$), while SHBG showed an inverse correlation ($\rho = -0.33$, $p = 0.001$). PCOS and insulin resistance significantly amplified the severity.

Conclusion:

Hormonal imbalance, particularly elevated free testosterone and low SHBG, plays a crucial role in the pathogenesis and severity of AOA. Recognition of underlying endocrine dysfunction is essential for comprehensive management.

Recommendations:

Routine hormonal evaluation should be incorporated in women presenting with persistent or severe AOA to guide individualized hormonal or metabolic therapy, ensuring optimal and sustained outcomes.

Keywords: *Adult-onset acne, Hormonal profile, Free testosterone, Sex Hormone–Binding Globulin, Polycystic Ovary Syndrome, Acne severity, Homeostatic Model Assessment of Insulin Resistance.*
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Introduction

Acne vulgaris is a chronic inflammatory disorder of the pilosebaceous unit, traditionally regarded as a disease of adolescence. However, in recent decades, the incidence of adult-onset acne (AOA) has shown a remarkable rise, particularly among women older than 25 years. Unlike adolescent acne, AOA is typically more persistent, resistant to conventional therapy, and associated with significant psychosocial distress and impaired quality of life [1,2].

The etiology of AOA is multifactorial, encompassing hormonal dysregulation, sebaceous gland hyperactivity, altered follicular keratinization, microbial dysbiosis, and

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chronic inflammatory responses. Among these, endocrine abnormalities, especially hyperandrogenism, play a pivotal role by stimulating sebaceous gland hypertrophy, increasing sebum production, and promoting follicular occlusion [3]. Elevated circulating androgens such as testosterone, dihydrotestosterone (DHT), and dehydroepiandrosterone sulfate (DHEA-S) enhance sebocyte proliferation and lipogenesis, while low levels of sex hormone–binding globulin (SHBG) increase the bioavailability of free androgens, thereby aggravating acne severity [4].

Emerging evidence further highlights the contribution of metabolic and reproductive factors, such as insulin resistance, elevated LH/FSH ratio, and polycystic ovary syndrome (PCOS), which act synergistically with androgen excess to exacerbate acne lesions [5]. These hormonal and metabolic disturbances often manifest with menstrual irregularities, hirsutism, and subclinical PCOS, yet many women remain undiagnosed unless systematically screened. Despite several global studies exploring the hormonal basis of adult acne, Indian data remain limited, and regional variations in hormonal profiles, lifestyle, and clinical patterns warrant further evaluation. Understanding the correlation between specific hormonal abnormalities and acne severity is essential to identify high-risk groups, promote early endocrine screening, and tailor individualized hormonal or metabolic interventions.

Hence, the present prospective observational study was undertaken to assess the correlation between serum hormonal profiles and acne severity in women with adult-onset acne, thereby contributing to improved diagnostic precision and individualized management strategies.

Materials and Methods

Study Design and Setting

This study followed a prospective observational design. It was conducted in the Department of Dermatology, Venereology, and Leprosy at Government General Hospital, Bhadradri Kothagudem, a large tertiary-care teaching hospital that caters to a predominantly rural and semi-urban population in Telangana. The hospital functions as the clinical wing of Government Medical College, Bhadradri Kothagudem, providing dermatology outpatient services, inpatient care, laboratory facilities, and dermatology specialty clinics. The study was carried out over a 12-month period from June 2024 to May 2025.

Study Population

Participants were recruited consecutively from the dermatology outpatient department. All eligible women were screened during routine clinic hours, and those fulfilling the inclusion criteria and providing written informed consent were enrolled.

Inclusion Criteria

Female patients aged 18–40 years with newly diagnosed or persistent adult-onset acne.

Willingness to provide informed written consent.

Not on any hormonal therapy, oral contraceptives, or systemic corticosteroids for at least 3 months before enrolment.

Exclusion Criteria

Pregnant or lactating women.

Patients with known endocrine disorders other than PCOS (e.g., Cushing's syndrome, thyroid carcinoma).

Women on isotretinoin, anti-androgens, or insulin-sensitizing agents in the last 6 months.

Those with severe systemic illness

Study Size

A total of 100 women were included in the study. The sample size was chosen based on feasibility and the average monthly dermatology outpatient load, which allowed adequate recruitment within the study period. Previous regional studies evaluating hormonal abnormalities in adult acne have used sample sizes between 80 and 120, making 100 participants sufficient to detect clinically meaningful correlations.

Data Collection and Clinical Assessment

Detailed demographic, menstrual, obstetric, and family history were recorded. Acne severity was assessed using the Global Acne Grading System (GAGS), categorizing patients into mild, moderate, or severe groups. Associated clinical signs such as hirsutism (Modified Ferriman-Gallwey score ≥8), seborrhea, and menstrual irregularity were documented.

Laboratory Evaluation

Venous blood samples were collected in the early follicular phase (days 2–5 of the menstrual cycle) after overnight fasting. The following serum parameters were estimated:

Total and free testosterone

Dehydroepiandrosterone sulfate (DHEA-S)

Sex hormone–binding globulin (SHBG)

Luteinizing hormone (LH) and Follicle-stimulating hormone (FSH) (for LH/FSH ratio)

17-hydroxyprogesterone, prolactin, and thyroid-stimulating hormone (TSH)

Fasting glucose and insulin for HOMA-IR (Homeostatic Model Assessment of Insulin Resistance) calculation.

All hormonal estimations were performed using chemiluminescent immunoassay **(CLIA)** on a fully automated analyzer under standardized quality control procedures.

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Diagnosis of PCOS

Polycystic ovary syndrome was diagnosed according to the Rotterdam criteria (2003), requiring the presence of at least two of the following:
Oligo/anovulation,
Clinical or biochemical hyperandrogenism,
Polycystic ovarian morphology on ultrasonography.

Efforts to minimize Bias

Efforts were undertaken to minimize potential sources of bias. Selection bias was reduced by using consecutive sampling of all eligible women attending the outpatient clinic. Information bias was minimized through standardized acne grading using the Global Acne Grading System (GAGS) and uniform laboratory procedures. All hormonal assays were performed in the same laboratory using a single automated chemiluminescent immunoassay platform. Observer bias was limited by having the same dermatology team conduct clinical examinations throughout the study.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY). Continuous variables were summarized as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. The correlation between hormonal parameters and acne severity (GAGS score) was examined using Spearman's rank correlation coefficient (ρ). Between-group comparisons were performed using ANOVA and the Kruskal–Wallis test, as these methods were appropriate for the distribution of the variables. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

Ethical clearance was obtained from the Institutional Ethics Committee of Government Medical College, Bhadradri Kothagudem. All participants provided written informed consent. The study adhered to the principles outlined in the Declaration of Helsinki.

Results

Participant Flow

During the study period, 128 women with suspected adult-onset acne presented to the dermatology outpatient clinic. Of these, 118 were examined for eligibility. Twelve women did not meet the inclusion criteria (6 were younger than 18 years, 3 had prior recent hormonal therapy, and 3 had known endocrine disorders other than PCOS). An additional six women were eligible but did not provide consent. A total of **100 women** were finally enrolled and underwent complete clinical assessment and laboratory evaluation. All enrolled participants had complete data and were included in the final analysis (Figure 1).

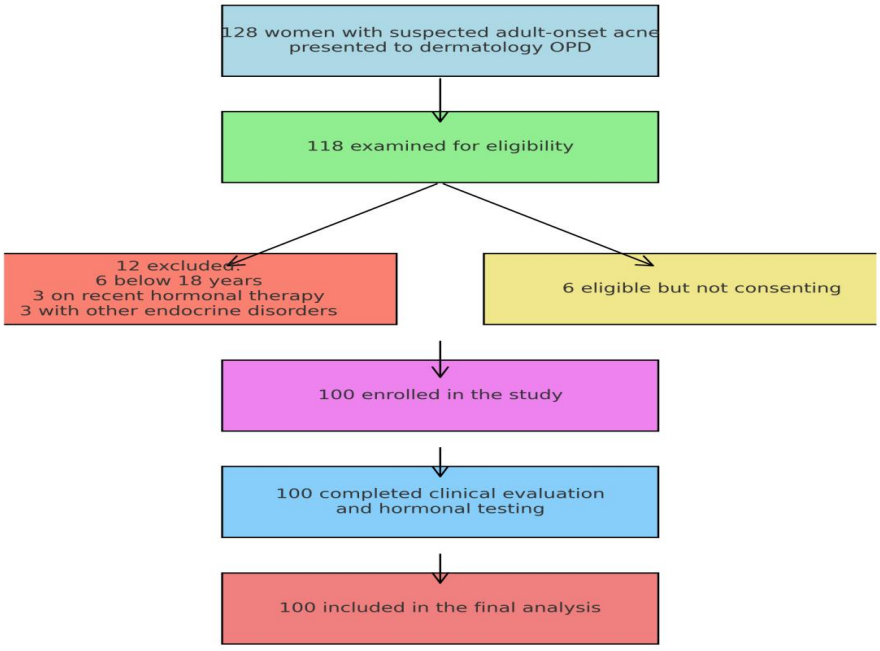

Figure 1: Participant Flow Diagram

A total of 100 women with adult-onset acne were enrolled in the study. The mean age of participants was 26.8 ± 4.9 years, with a mean body mass index (BMI) of 24.1 ± 3.6 kg/m². The mean age at acne onset was 23.4 ± 3.8 years. Menstrual irregularities were noted in 38% of participants, while hirsutism (mFG ≥ 8) was present in 30%. Polycystic

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ovary syndrome (PCOS), diagnosed according to Rotterdam criteria, was identified in 41% of the women. Family history of acne was reported by 27%, and emotional stress was identified as an exacerbating factor in 52% of cases (Table 1).

Table 1. Baseline Characteristics of Study Participants (n = 100)

Variable	Mean ± SD / n (%)
Age (years)	26.8 ± 4.9
Body Mass Index (kg/m²)	24.1 ± 3.6
Age at Onset of Acne (years)	23.4 ± 3.8
Menstrual Irregularity	38 (38.0)
Hirsutism (mFG ≥ 8)	30 (30.0)
Polycystic Ovary Syndrome (PCOS)*	41 (41.0)
Family History of Acne	27 (27.0)
Stress as an Exacerbating Factor	52 (52.0)

**PCOS diagnosed by Rotterdam criteria.*

Acne Severity

According to the Global Acne Grading System (GAGS), 28% of the study population exhibited mild acne, 46% had moderate acne, and 26% had severe acne. The mean GAGS score across the cohort was 22.9 ± 6.7, with a median of 22 (IQR 16–30). The face was the most frequently affected site (92%), followed by the back (27%) and chest (18%) (Table 2).

Table 2. Distribution of Acne Severity and Clinical Findings (GAGS Classification)

Acne Severity	n (%)	Mean GAGS Score ± SD
Mild	28 (28.0)	15.8 ± 2.3
Moderate	46 (46.0)	23.4 ± 3.1
Severe	26 (26.0)	32.7 ± 4.8
Total (n = 100)	100 (100.0)	**22.9 ± 6.7**

The median Global Acne Grading System (GAGS) score was 22 (IQR: 16–30). The face was the most commonly affected site (92%), followed by the back (27%) and chest (18%).

Hormonal Profiles

Evaluation of serum hormonal parameters demonstrated that 34% of participants had elevated free testosterone and 29% had increased total testosterone levels. Raised DHEA-S levels were noted in 22%, while 26% showed reduced sex hormone–binding globulin (SHBG). An elevated LH/FSH ratio (≥2) was present in 31%, and insulin resistance (HOMA-IR ≥ 2.5) in 37%. Mild hyperprolactinemia was found in 9% and thyroid dysfunction in 7%. The mean values of all hormonal parameters are presented in Table 3.

Table 3. Hormonal Profile among Women with Adult-Onset Acne

Hormonal Parameter	Normal Range	Mean ± SD	Abnormal Values n (%)
Total Testosterone (ng/mL)	0.1–0.7	0.82 ± 0.31	29 (29.0)
Free Testosterone (pg/mL)	0.5–3.9	4.5 ± 1.8	34 (34.0)
DHEA-S (µg/dL)	35–430	412 ± 136	22 (22.0)
SHBG (nmol/L)	18–114	34.2 ± 10.6	26 (26.0)*
LH/FSH Ratio	< 2.0	2.1 ± 0.9	31 (31.0)
17-Hydroxyprogesterone (ng/mL)	0.3–2.0	1.4 ± 0.7	4 (4.0)
Prolactin (ng/mL)	3–25	17.9 ± 8.4	9 (9.0)
TSH (mIU/L)	0.4–4.0	2.9 ± 1.3	7 (7.0)
HOMA-IR (≥2.5)	—	3.1 ± 1.4	37 (37.0)

**Low SHBG is defined as <30 nmol/L*

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Correlation between Hormones and Acne Severity

Spearman's rank correlation analysis revealed a significant positive correlation between acne severity and free testosterone ($\rho = 0.41$, $p < 0.001$), total testosterone ($\rho = 0.32$, $p = 0.002$), DHEA-S ($\rho = 0.29$, $p = 0.004$), and LH/FSH ratio ($\rho = 0.24$, $p = 0.016$). Conversely, SHBG demonstrated a significant inverse correlation with acne severity ($\rho = –0.33$, $p = 0.001$). Prolactin and TSH levels showed no significant correlation ($p > 0.05$) (Table 4).

Table 4. Correlation between Hormonal Parameters and Acne Severity (Spearman's Rank Test)

Parameter	Correlation Coefficient (ρ)	p-Value	Interpretation
Free Testosterone	0.41	<0.001	Strong positive correlation
Total Testosterone	0.32	0.002	Moderate positive correlation
DHEA-S	0.29	0.004	Moderate positive correlation
LH/FSH Ratio	0.24	0.016	Mild positive correlation
SHBG	–0.33	0.001	Significant inverse correlation
Prolactin	0.09	0.37	Not significant
TSH	0.05	0.62	Not significant

Elevated free testosterone, low SHBG, and a higher LH/FSH ratio were significantly associated with greater acne severity. Insulin resistance and PCOS status amplified this relationship ($p < 0.05$).

Discussion

The present prospective observational study evaluated the hormonal correlates of acne severity among 100 women with adult-onset acne (AOA). The mean age of participants was 26.8 years, consistent with the age range most frequently reported for post-adolescent acne in women [6,7]. Nearly half of the patients presented with moderate acne, and 26% exhibited severe lesions, highlighting the chronic and relapsing nature of AOA.

Hormonal Imbalance and Acne Severity

This study identified a significant positive correlation between acne severity and free testosterone, total testosterone, DHEA-S, and LH/FSH ratio, whereas SHBG demonstrated a negative association. These findings confirm the critical role of androgen excess and reduced SHBG in acne pathophysiology. Similar patterns were reported in studies that evaluated serum androgen levels and their relationship with disease severity [6,12]. The inverse relationship between SHBG and acne severity observed in this study further supports the influence of bioavailable androgens, a finding consistent with previous reports linking low SHBG to insulin resistance and increased acne severity [7].

PCOS and Metabolic Influences

In the present cohort, 41% of women fulfilled the Rotterdam criteria for PCOS, comparable to earlier regional studies reporting a prevalence of 35–50% among women with persistent acne [8,10]. The coexistence of menstrual irregularities and hirsutism reinforces the endocrine–metabolic interplay in acne pathogenesis. Participants with PCOS demonstrated higher GAGS scores and elevated free testosterone and HOMA-IR values, reaffirming the synergistic effect of insulin resistance and hyperandrogenism. Comparable observations have been described in research evaluating hormonal and metabolic profiles in women with PCOS-related acne [9]. Additional evidence suggests that insulin resistance can intensify acne severity by amplifying androgenic drive even in the absence of overt PCOS [9].

Thyroid and Prolactin Findings

A small proportion of women showed mild hyperprolactinemia (9%) or thyroid dysfunction (7%), but neither demonstrated a meaningful association with acne severity. Although the role of prolactin in sebaceous biology remains uncertain, some literature has proposed that it may indirectly influence acne through effects on gonadotropin regulation. These findings are broadly in line with earlier studies that described hormonal disturbances contributing to acne manifestations in women with PCOS [10].

Clinical and Therapeutic Implications

The present findings emphasize the need for comprehensive hormonal and metabolic assessment in women with adult-onset acne, particularly those with severe, persistent, or treatment-resistant disease. Updated dermatology guidelines also recommend integrating endocrine evaluation into acne management for women with suspected hormonal involvement [11]. Detecting abnormalities such as hyperandrogenemia or insulin resistance enables more targeted interventions, including anti-androgens, hormonal therapy, and insulin-sensitizing agents, thereby improving treatment response and reducing relapse rates.

Generalizability

Findings are generalizable to women with adult-onset acne attending tertiary-care dermatology clinics in similar demographic and climatic settings. However, multicentric studies across diverse populations are required to validate hormonal and metabolic correlations and strengthen clinical applicability.

Conclusion

This prospective observational study highlights that androgen excess, low SHBG, and insulin resistance are significant determinants of acne severity among women with adult-onset acne. Elevated free testosterone and reduced SHBG levels showed the strongest associations, emphasizing the influence of hormonal imbalance on sebaceous gland activity. Nearly half of the participants exhibited biochemical or clinical features of PCOS, underscoring the interplay between metabolic and reproductive endocrinology. Recognition of these underlying abnormalities is essential for early diagnosis and targeted therapy. Incorporating routine hormonal evaluation and metabolic assessment into acne management can ensure personalized, effective, and sustainable treatment outcomes in adult women.

Limitations

The present study was limited by its single-center design, moderate sample size, and lack of longitudinal hormonal monitoring. Dynamic hormonal fluctuations across menstrual cycles were not evaluated, which might influence biochemical interpretation and acne severity correlation.

Recommendations

Routine hormonal profiling should be incorporated into the evaluation of women presenting with persistent or severe adult-onset acne. Identifying hyperandrogenemia, insulin resistance, or PCOS at an early stage enables the use of targeted interventions such as anti-androgens, hormonal modulators, or insulin-sensitizing agents. Collaboration between dermatologists, endocrinologists, and gynecologists is essential for integrated management. Lifestyle modification, including dietary regulation and weight optimization, should also be emphasized to improve hormonal balance and reduce recurrence.

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The authors sincerely acknowledge the Department of Dermatology, Government Medical College and General Hospital, Bhadradri Kothagudem, for providing necessary facilities and clinical support throughout the study.

Abbreviations

AOA – Adult-Onset Acne
BMI – Body Mass Index
CLIA – Chemiluminescent Immunoassay
DHEA-S – Dehydroepiandrosterone Sulfate
FSH – Follicle-Stimulating Hormone
GAGS – Global Acne Grading System
HOMA-IR – Homeostatic Model Assessment of Insulin Resistance
LH – Luteinizing Hormone
mFG – Modified Ferriman–Gallwey
PCOS – Polycystic Ovary Syndrome
SD – Standard Deviation
SHBG – Sex Hormone–Binding Globulin
SPSS – Statistical Package for the Social Sciences
TSH – Thyroid-Stimulating Hormone

Source of funding

The study had no funding.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

MKRT-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. **VG-**Concept and design of the study, results interpretation, review of literature, preparing the first draft of the manuscript, and revision of the manuscript.**GG-**Review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation.

Data availability

Data is available on request

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