



CORRELATION OF CUTANEOUS MANIFESTATIONS WITH HORMONAL PROFILE IN WOMEN WITH POLYCYSTIC OVARY SYNDROME

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Abstract

Background: Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine disorders among women of reproductive age and is frequently associated with various cutaneous manifestations resulting from hyperandrogenism and insulin resistance. Dermatological features such as hirsutism, acne, acanthosis nigricans, and androgenetic alopecia may serve as important clinical indicators of underlying hormonal abnormalities. Understanding the relationship between these manifestations and hormonal profiles can facilitate early diagnosis and management of PCOS.

Aim To evaluate the correlation between cutaneous manifestations and hormonal profile in women with Polycystic Ovary Syndrome.

Materials and Methods This hospital-based cross-sectional observational study included 100 women diagnosed with PCOS according to the Rotterdam criteria. Detailed demographic, clinical, and dermatological evaluations were performed. Cutaneous manifestations including hirsutism, acne vulgaris, acanthosis nigricans, androgenetic alopecia, seborrhea, skin tags, and other findings were documented. Hormonal assessment included measurement of total testosterone, free testosterone, DHEAS, LH, FSH, LH/FSH ratio, prolactin, TSH, SHBG, and fasting insulin levels. Correlation between dermatological manifestations and hormonal parameters was analyzed using appropriate statistical tests, with $p < 0.05$ considered statistically significant.

Results The majority of participants belonged to the 21–25 years age group (42.0%), and 76.0% were either overweight or obese. Hirsutism was the most common cutaneous manifestation (72.0%), followed by acne vulgaris (65.0%), acanthosis nigricans (58.0%), seborrhea (47.0%), and androgenetic alopecia (34.0%). Mean total testosterone and free testosterone levels were 78.34 ± 26.15 ng/dL and 5.82 ± 2.31 pg/mL, respectively. Hirsutism severity showed significant positive correlations with total testosterone ($r = 0.62$, $p < 0.001$) and free testosterone ($r = 0.58$, $p < 0.001$). Acne severity was significantly associated with total testosterone, free testosterone, and DHEAS levels. Acanthosis nigricans demonstrated a strong positive correlation with fasting insulin levels ($r = 0.65$, $p < 0.001$) and BMI ($r = 0.54$, $p < 0.001$). Women with hirsutism had significantly higher androgen levels and lower SHBG levels compared to those without hirsutism.

Conclusion Cutaneous manifestations are highly prevalent in women with PCOS and demonstrate significant correlations with hormonal and metabolic abnormalities. Hirsutism, acne, and androgenetic alopecia were primarily associated with hyperandrogenism, whereas acanthosis nigricans was strongly

linked to insulin resistance. Dermatological evaluation can serve as an important clinical tool for identifying underlying endocrine dysfunction and facilitating early diagnosis and comprehensive management of PCOS.

Keywords: Polycystic Ovary Syndrome; PCOS; Cutaneous Manifestations; Hirsutism; Acne Vulgaris; Acanthosis Nigricans; Hyperandrogenism; Hormonal Profile; Insulin Resistance; Androgenetic Alopecia.

Introduction

Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine disorders affecting women of reproductive age, with a prevalence ranging from 6% to 20% depending on the diagnostic criteria used and the population studied. It is characterized by a combination of hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology and is associated with significant reproductive, metabolic, and dermatological manifestations. The diagnosis of PCOS is most commonly based on the Rotterdam criteria, which require the presence of at least two of the following features: oligo/anovulation, clinical or biochemical hyperandrogenism, and polycystic ovaries on ultrasonography, after excluding other etiologies.[1,2]

PCOS is a heterogeneous disorder with a complex pathophysiology involving genetic predisposition, insulin resistance, hyperinsulinemia, and hormonal imbalance. Hyperinsulinemia plays a central role by enhancing ovarian androgen production and suppressing hepatic synthesis of sex hormone-binding globulin (SHBG), thereby increasing circulating free androgen levels. Elevated androgen concentrations contribute significantly to the development of various cutaneous manifestations commonly observed in women with PCOS.[3,4]

Cutaneous manifestations are often among the earliest and most visible clinical signs of PCOS, prompting affected women to seek medical attention. The most common dermatological features include hirsutism, acne vulgaris, androgenetic alopecia, seborrhea, acanthosis nigricans, skin tags, and less commonly, hidradenitis suppurativa. These manifestations arise primarily due to androgen excess and insulin resistance and may substantially affect self-esteem, body image, and quality of life.[5,6]

Hirsutism is considered the most frequent dermatological manifestation of PCOS and is reported in approximately 60–80% of affected women. It results from excessive androgen-mediated transformation of vellus hair into terminal hair in androgen-sensitive body areas. Acne and androgenetic alopecia are also frequently encountered and are believed to reflect increased sensitivity of pilosebaceous units to circulating androgens. Acanthosis nigricans, characterized by hyperpigmented velvety plaques in intertriginous areas, is strongly associated with insulin resistance and hyperinsulinemia, which are prevalent in women with PCOS.[7,8]

Hormonal abnormalities in PCOS include elevated serum testosterone, dehydroepiandrosterone sulfate (DHEAS), luteinizing hormone (LH), LH/FSH ratio, anti-Müllerian hormone (AMH), and insulin levels, along with reduced SHBG concentrations. Several studies have suggested that the severity and pattern of cutaneous manifestations may correlate with specific hormonal derangements; however, the strength and consistency of these associations remain variable across different populations. While some studies have demonstrated a significant relationship between androgen levels and hirsutism or acne severity, others have reported poor correlation, suggesting the influence of peripheral androgen sensitivity and genetic factors.[9,10]

Understanding the relationship between cutaneous manifestations and hormonal profiles in women with PCOS is clinically important because dermatological signs may serve as visible markers of underlying endocrine dysfunction. Early recognition of these manifestations can facilitate prompt diagnosis, hormonal evaluation, and timely intervention, thereby reducing long-term reproductive and metabolic complications associated with PCOS.[11]

Despite the high prevalence of dermatological manifestations in PCOS, limited data are available regarding their correlation with hormonal parameters in the Indian population. Therefore, the present study was undertaken to evaluate the spectrum of cutaneous manifestations in women with PCOS and to assess their correlation with hormonal profiles, thereby contributing to improved

Material And Methods

Study Design

A hospital-based cross-sectional observational study was conducted to evaluate the correlation between cutaneous manifestations and hormonal profile in women diagnosed with Polycystic Ovary Syndrome (PCOS).

Study Setting

The study was conducted in the Departments of Dermatology and Obstetrics & Gynecology at a tertiary care teaching hospital.

Study Population

Women diagnosed with PCOS who attended the Dermatology and Gynecology outpatient departments during the study period were enrolled in the study.

Sampling Technique

Consecutive eligible patients presenting during the study period were recruited until the desired sample size was achieved.

Inclusion Criteria

Patients who fulfilled the following criteria were included in the study:

1. Women aged 15–45 years.
2. Patients diagnosed with PCOS according to the Rotterdam criteria (2003).
3. Patients willing to participate and provide written informed consent.

Exclusion Criteria

Patients were excluded if they had:

1. Pregnancy or lactation.
2. Thyroid disorders, Cushing syndrome, congenital adrenal hyperplasia, androgen-secreting tumors, or hyperprolactinemia.
3. Received hormonal therapy, anti-androgens, oral contraceptive pills, corticosteroids, or insulin-sensitizing agents within the preceding three months.
4. Any systemic illness affecting hormonal status.
5. Refused to provide informed consent.

Ethical Considerations

Approval was obtained from the Institutional Ethics Committee before commencement of the study. Written informed consent was obtained from all participants prior to enrollment. Confidentiality of patient information was maintained throughout the study.

Data Collection Procedure

After obtaining informed consent, detailed demographic information including age, marital status, occupation, menstrual history, duration of symptoms, and family history of PCOS was recorded using a predesigned case record form.

A comprehensive general physical examination and dermatological examination were performed in all participants.

Assessment of Cutaneous Manifestations

The presence and severity of cutaneous manifestations associated with hyperandrogenism and insulin resistance were assessed and documented.

Hirsutism

Hirsutism was assessed using the Modified Ferriman-Gallwey (mFG) scoring system. An mFG score of ≥ 8 was considered indicative of hirsutism.

Acne

Acne severity was graded according to the Global Acne Grading System (GAGS) and categorized as mild, moderate, severe, or very severe.

Androgenetic Alopecia

Female pattern hair loss was evaluated using the Ludwig classification.

Acanthosis Nigricans

The presence and anatomical distribution of acanthosis nigricans were recorded.

Other Cutaneous Findings

Seborrhea, skin tags (acrochordons), hidradenitis suppurativa, and other dermatological manifestations were assessed and documented whenever present.

Hormonal Evaluation

Venous blood samples were collected from all participants during the early follicular phase of the menstrual cycle (days 2–5) or at a random time in amenorrheic women.

The following hormonal parameters were measured:

1. Serum Total Testosterone
2. Free Testosterone
3. Dehydroepiandrosterone Sulfate (DHEAS)
4. Luteinizing Hormone (LH)
5. Follicle Stimulating Hormone (FSH)
6. LH/FSH Ratio
7. Prolactin
8. Thyroid Stimulating Hormone (TSH)
9. Sex Hormone Binding Globulin (SHBG)
10. Fasting Insulin

All biochemical analyses were performed in the central laboratory using standardized methods.

Anthropometric Assessment

Height and weight were measured using standard techniques. Body Mass Index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2). Waist circumference and waist-hip ratio were also recorded.

Ultrasonographic Assessment

Pelvic ultrasonography was performed to evaluate ovarian morphology. The diagnosis of polycystic ovaries was based on the Rotterdam criteria.

Outcome Measures

Primary Outcome

To determine the correlation between various cutaneous manifestations and hormonal parameters in women with PCOS.

Secondary Outcomes

1. To determine the prevalence of different cutaneous manifestations in PCOS.
2. To evaluate the association between insulin resistance markers and dermatological findings.
3. To assess the relationship between severity of cutaneous manifestations and hormonal abnormalities.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 26.

Continuous variables were expressed as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR), whereas categorical variables were expressed as frequency and percentage.

The association between categorical variables was analyzed using the Chi-square test or Fisher's exact test. Correlation between hormonal parameters and cutaneous manifestations was assessed using Pearson's or Spearman's correlation coefficient as appropriate. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 100 women diagnosed with PCOS were included in the study. The demographic and clinical characteristics of the study participants are presented in Table 1. The majority of participants belonged to the 21–25 years age group (42.0%), followed by the 26–30 years age group (28.0%). Most patients were either overweight (38.0%) or obese (38.0%). Menstrual irregularities were common, with oligomenorrhea being the most frequently observed pattern (61.0%), followed

by amenorrhea (17.0%) (Table 1).

The distribution of cutaneous manifestations among women with PCOS is shown in Table 2 and Figure 1. Hirsutism was the most prevalent dermatological manifestation, affecting 72.0% of patients, followed by acne vulgaris (65.0%) and acanthosis nigricans (58.0%). Seborrhea was observed in 47.0% of participants, whereas androgenetic alopecia was present in 34.0%. Skin tags, striae distensae, hyperpigmentation, and hidradenitis suppurativa were observed less frequently (Table 2, Figure 1).

The hormonal profile of the study participants is summarized in Table 3. The mean total testosterone level was 78.34 ± 26.15 ng/dL, while the mean free testosterone level was 5.82 ± 2.31 pg/mL. The mean DHEAS concentration was 284.57 ± 102.44 µg/dL. Elevated LH levels and an increased LH/FSH ratio were observed in a substantial proportion of patients, with mean values of 11.21 ± 4.35 mIU/mL and 2.06 ± 0.88 , respectively. The mean fasting insulin level was 18.63 ± 7.25 µIU/mL, indicating the presence of insulin resistance in many participants (Table 3).

Correlation analysis demonstrated significant associations between cutaneous manifestations and hormonal parameters (Table 4). Hirsutism severity showed a strong positive correlation with total testosterone ($r = 0.62$, $p < 0.001$) and free testosterone levels ($r = 0.58$, $p < 0.001$). Acne severity was positively correlated with total testosterone ($r = 0.49$, $p < 0.001$), DHEAS ($r = 0.44$, $p < 0.001$), and free testosterone levels ($r = 0.41$, $p < 0.001$). Acanthosis nigricans demonstrated the strongest correlation with fasting insulin levels ($r = 0.65$, $p < 0.001$) and BMI ($r = 0.54$, $p < 0.001$). Alopecia severity also showed significant positive correlations with total testosterone and DHEAS levels (Table 4).

A comparison of hormonal parameters between patients with and without hirsutism is presented in Table 5. Women with hirsutism had significantly higher mean levels of total testosterone, free testosterone, DHEAS, LH, LH/FSH ratio, and fasting insulin compared to those without hirsutism ($p < 0.05$ for all comparisons). Conversely, SHBG levels were significantly lower among women with hirsutism. No statistically significant difference was observed in FSH levels between the two groups ($p = 0.216$) (Table 5).

Table 1. Demographic and Clinical Characteristics of Study Participants (n = 100)

Variable	n (%)
Age Group (years)	
15–20	18 (18.0)
21–25	42 (42.0)
26–30	28 (28.0)
31–35	9 (9.0)
>35	3 (3.0)
BMI Category	
Normal (<25 kg/m ²)	24 (24.0)
Overweight (25–29.9 kg/m ²)	38 (38.0)
Obese (≥30 kg/m ²)	38 (38.0)
Marital Status	
Married	58 (58.0)
Unmarried	42 (42.0)
Menstrual Pattern	
Oligomenorrhea	61 (61.0)
Amenorrhea	17 (17.0)
Regular Cycles	22 (22.0)

Table 2. Distribution of Cutaneous Manifestations in Women with PCOS (n = 100)

Cutaneous Manifestation	n	%
Hirsutism	72	72.0
Acne Vulgaris	65	65.0

Acanthosis Nigricans	58	58.0
Androgenetic Alopecia	34	34.0
Seborrhea	47	47.0
Skin Tags (Acrochordons)	26	26.0
Striae Distensae	18	18.0
Hidradenitis Suppurativa	7	7.0
Hyperpigmentation	15	15.0

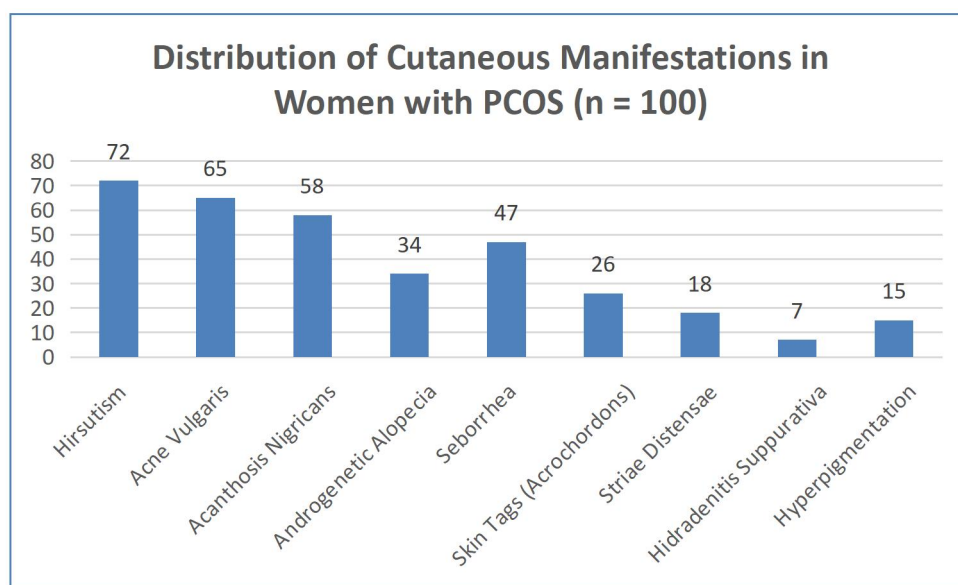


Figure 1 Distribution of Cutaneous Manifestations in Women with PCOS (n = 100)

Table 3. Hormonal Profile of Women with PCOS (n = 100)

Hormonal Parameter	Mean $\pm$ SD	Range
Total Testosterone (ng/dL)	78.34 $\pm$ 26.15	32–156
Free Testosterone (pg/mL)	5.82 $\pm$ 2.31	1.4–12.6
DHEAS (μ g/dL)	284.57 $\pm$ 102.44	95–512
LH (mIU/mL)	11.21 $\pm$ 4.35	3.2–24.5
FSH (mIU/mL)	5.63 $\pm$ 1.74	2.4–10.2
LH/FSH Ratio	2.06 $\pm$ 0.88	0.8–4.8
Prolactin (ng/mL)	16.48 $\pm$ 5.76	6–32
TSH (μ IU/mL)	2.84 $\pm$ 1.12	0.6–5.8
SHBG (nmol/L)	28.54 $\pm$ 10.82	10–62
Fasting Insulin (μ IU/mL)	18.63 $\pm$ 7.25	6–38

Table 4. Correlation of Cutaneous Manifestations with Hormonal Parameters

Cutaneous Manifestation	Hormonal Parameter	Correlation Coefficient (r)	p-value
Hirsutism (mFG Score)	Total Testosterone	0.62	<0.001
Hirsutism (mFG Score)	Free Testosterone	0.58	<0.001
Hirsutism (mFG Score)	LH/FSH Ratio	0.36	0.001

Acne Severity	Total Testosterone	0.49	<0.001
Acne Severity	DHEAS	0.44	<0.001
Acne Severity	Free Testosterone	0.41	<0.001
Acanthosis Nigricans	Fasting Insulin	0.65	<0.001
Acanthosis Nigricans	BMI	0.54	<0.001
Alopecia Severity	Total Testosterone	0.39	<0.001
Alopecia Severity	DHEAS	0.34	0.002

Table 5. Comparison of Hormonal Profile According to Presence of Hirsutism

Hormonal Parameter	Hirsutism Present (n=72) Mean $\pm$ SD	Hirsutism Absent (n=28) Mean $\pm$ SD	p-value
Total Testosterone (ng/dL)	88.62 $\pm$ 23.41	52.18 $\pm$ 17.86	<0.001
Free Testosterone (pg/mL)	6.54 $\pm$ 2.08	3.96 $\pm$ 1.42	<0.001
DHEAS (μ g/dL)	309.27 $\pm$ 95.84	221.03 $\pm$ 78.52	<0.001
LH (mIU/mL)	12.04 $\pm$ 4.18	9.08 $\pm$ 3.22	0.002
FSH (mIU/mL)	5.48 $\pm$ 1.63	5.97 $\pm$ 1.89	0.216
LH/FSH Ratio	2.28 $\pm$ 0.91	1.52 $\pm$ 0.64	<0.001
SHBG (nmol/L)	24.82 $\pm$ 8.94	38.12 $\pm$ 11.23	<0.001
Fasting Insulin (μ IU/mL)	20.54 $\pm$ 6.88	13.72 $\pm$ 4.96	<0.001

Discussion

Polycystic ovary syndrome (PCOS) is a common endocrine disorder affecting women of reproductive age and is frequently associated with dermatological manifestations resulting from hyperandrogenism and insulin resistance. In the present study, most participants belonged to the 21–25 years age group (42%), with a mean age of 25.78 ± 4.86 years. Similar observations were reported by Palep-Singh et al. [12], highlighting that PCOS predominantly affects young women during their reproductive years.

A large proportion of participants were overweight or obese (76%), supporting the findings of Escobar-Morreale [5], who emphasized the role of obesity and insulin resistance in the pathogenesis of PCOS. Increased adiposity contributes to hyperinsulinemia and enhanced ovarian androgen production, thereby aggravating both endocrine and cutaneous manifestations. Menstrual irregularities were common, with oligomenorrhea observed in 61% and amenorrhea in 17% of patients, findings comparable to those described by Franks [3], who identified chronic anovulation as a hallmark feature of PCOS.

Among the dermatological manifestations, hirsutism was the most prevalent finding, affecting 72% of participants. This is consistent with the prevalence of 60–80% reported by Carmina and Lobo [7]. Hirsutism remains one of the most reliable clinical indicators of hyperandrogenism and reflects increased androgen activity at the pilosebaceous unit. Acne vulgaris was present in 65% of women, similar to the prevalence reported by Sharquie et al. [8], who documented acne in approximately

58–70% of PCOS patients. Elevated androgen levels stimulate sebaceous gland activity and follicular keratinization, contributing to acne development.

Acanthosis nigricans was observed in 58% of participants, supporting the findings of Dunaif [4], who demonstrated its strong association with insulin resistance. Hyperinsulinemia promotes epidermal proliferation through insulin-like growth factor pathways, resulting in characteristic hyperpigmented plaques. Androgenetic alopecia was identified in 34% of patients, which is comparable to the 20–40% prevalence reported in previous studies. This manifestation is primarily attributed to androgen-mediated follicular miniaturization.

Hormonal evaluation revealed elevated levels of total testosterone, free testosterone, DHEAS, LH, and LH/FSH ratio, consistent with the observations of Azziz et al. [2], who described hyperandrogenemia as a central endocrine abnormality in PCOS. A significant positive correlation was found between hirsutism severity and total testosterone levels ($r = 0.62$, $p < 0.001$), similar to the findings of Yildiz et al. [9]. Free testosterone levels also demonstrated a significant association with hirsutism, suggesting that biologically active androgen fractions may better reflect clinical severity.

Acne severity showed significant positive correlations with total testosterone, free testosterone, and DHEAS levels, corroborating the findings of Palep-Singh et al. [12]. Furthermore, acanthosis nigricans exhibited strong correlations with fasting insulin ($r = 0.65$, $p < 0.001$) and BMI ($r = 0.54$, $p < 0.001$), in agreement with Dunaif [4] and Goodman et al. [6], who identified it as an important marker of insulin resistance and metabolic dysfunction.

Overall, the present study demonstrates that hirsutism, acne, and androgenetic alopecia are closely associated with hyperandrogenism, whereas acanthosis nigricans is strongly linked to insulin resistance. These findings highlight the importance of careful dermatological assessment in women with PCOS, as cutaneous manifestations may serve as valuable clinical indicators of underlying endocrine and metabolic abnormalities.

Conclusion

The present study demonstrated that cutaneous manifestations are highly prevalent among women with Polycystic Ovary Syndrome, with hirsutism, acne vulgaris, and acanthosis nigricans being the most common findings. Significant positive correlations were observed between hyperandrogenic skin manifestations and elevated androgen levels, while acanthosis nigricans showed a strong association with insulin resistance. Women with hirsutism exhibited significantly higher levels of total testosterone, free testosterone, DHEAS, LH/FSH ratio, and fasting insulin. These findings highlight the importance of dermatological evaluation as a useful clinical indicator of underlying hormonal and metabolic abnormalities in women with PCOS, facilitating early diagnosis and comprehensive management.

Limitations

The study was conducted at a single tertiary care center with a relatively limited sample size, which may restrict the generalizability of the findings. The cross-sectional design precluded the assessment of temporal or causal relationships between hormonal abnormalities and cutaneous manifestations. Additionally, hormonal parameters were measured at a single time point and may not fully reflect long-term endocrine fluctuations. Longitudinal multicenter studies with larger sample sizes are needed to validate these findings.

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