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Original Research Article

Hormonal and Immunological Correlations in Alopecia Areata Patients: Focus on Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH)

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Abstract: ***Background*:** Alopecia areata (AA) is an autoimmune disorder characterized by patchy, reversible hair loss. Increasing evidence suggests that immune dysregulation and hormonal imbalance may play a role in disease onset and progression. ***Objective*:** This study aimed to investigate the relationship between luteinizing hormone (LH) and follicle-stimulating hormone (FSH) levels in patients with alopecia areata compared with healthy controls, and to assess their potential role in disease pathogenesis. ***Methods*:** A case–control study was conducted on 72 participants (42 patients with AA and 30 healthy volunteers) attending the dermatology outpatient clinic at Al-Ramadi Hospital, Al-Anbar, Iraq, between December 2019 and March 2020. Detailed clinical history and dermatological examination were obtained. Venous blood samples (5 mL) were collected, and serum LH and FSH levels were measured using standard laboratory techniques. Data were analyzed for age and gender distribution, and statistical significance was determined at $p < 0.05$. ***Results*:** Patients with AA demonstrated significantly higher LH and FSH concentrations compared with controls. LH levels were elevated across all age groups (mean 6.97 IU/mL vs. 4.62 IU/mL, $p < 0.001$). Similarly, FSH levels were higher in patients (mean 7.96 IU/mL) than controls (mean 4.93 IU/mL, $p < 0.05$). Gender analysis revealed significantly higher LH and FSH in both males and females with AA compared to controls. ***Conclusion*:** This study highlights a strong correlation between alopecia areata and elevated pituitary gonadotropins (LH and FSH). Screening for hormonal abnormalities in AA patients may provide insights into disease mechanisms and guide early therapeutic strategies, particularly in relation to immune-endocrine interactions.

Keywords: Alopecia Areata, Luteinizing Hormone, Follicle-Stimulating Hormone, Autoimmunity, Hormonal Imbalance.

INTRODUCTION

Alopecia areata (AA) is a chronic, immune-mediated, non-scarring hair loss disorder that typically presents as well-demarcated patches on the scalp or other hair-bearing sites, including the beard, eyebrows, and eyelashes (Strazzulla *et al.,* 2023). The pathogenesis of AA is multifactorial, involving genetic predisposition, autoimmune dysregulation, and environmental triggers. A central mechanism is the collapse of the immune privilege of hair follicles, leading to autoreactive T-cell infiltration and disruption of the normal hair cycle (Strazzulla *et al.,* 2023; Ma *et al.,* 2025).

Recent evidence suggests that hormonal regulation also contributes to AA pathophysiology. Sex hormones, including estrogen, progesterone, and androgens, play a pivotal role in modulating follicular cycling and influencing the perifollicular immune microenvironment (Singh *et al.,* 2023; Ma *et al.,* 2025). Disturbances in pituitary gonadotropins, such as luteinizing hormone (LH) and follicle-stimulating hormone (FSH), may therefore alter both immune responses and hair follicle homeostasis (Ranasinghe *et al.,* 2016; Owecka *et al.,* 2024). Clinical studies on non-scarring alopecia have highlighted the hormonal background of hair loss, with abnormal LH/FSH ratios observed in some patients (Carmina *et al.,* 2006).

In addition, microbiome-immune interactions have recently been implicated in AA, where cutaneous and gut dysbiosis may act as environmental factors shaping disease activity (Burma *et al.,* 2025). Experimental models also support a direct role of LH in hair follicle biology; Wu *et al.* (2025). Demonstrated that elevated LH can induce hair loss in murine models, providing mechanistic evidence for gonadotropin involvement (Wu *et al.,* 2025).

Despite these insights, the relationship between AA and pituitary hormones remains underexplored. Thus, the present study aimed to evaluate serum LH and FSH levels in patients with AA compared to healthy controls, in order to clarify their role in disease mechanisms and assess their potential as biomarkers of disease activity.

MATERIALS AND METHODS

Study Design and Participants

This case–control study was conducted at the Dermatology Outpatient Clinic of Al-Ramadi Hospital, Al-Anbar, Iraq, between December 2019 and March 2020. A total of 72 individuals were enrolled, including 42 patients clinically diagnosed with alopecia areata (AA) (Group A) and 30 healthy age- and sex-matched volunteers who served as the control group (Group B).

Inclusion Criteria Were:

- Age between 10–50 years.
- Clinical diagnosis of AA confirmed by a dermatologist.

Exclusion Criteria Included:

- History of thyroid, adrenal, or other major endocrine disorders.
- Use of hormonal therapy or immunosuppressive drugs in the last 6 months.
- Presence of systemic autoimmune diseases (e.g., systemic lupus erythematosus).

Ethical Considerations

The study was approved by the Ethics Committee of the College of Medicine, University of Anbar, and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants or from guardians of participants under 18 years of age.

Data Collection

A detailed clinical history was obtained from each participant, including:

- Onset and course of AA.
- Family history of alopecia or autoimmune disease.
- Associated systemic conditions.

All participants underwent a full dermatological examination to confirm the diagnosis of AA and classify its type (patchy, totalis, universalis).

Blood Sampling and Hormone Measurement

Venous blood samples (5 mL) were collected from each participant after an overnight fast. Samples were centrifuged at 4000 rpm for 5 minutes, and serum was separated for analysis. Serum luteinizing hormone (LH) and follicle-stimulating hormone (FSH) levels were measured using commercially available immunoassay kits (e.g., ELISA-based methods) according to the manufacturer's instructions.

Statistical Analysis

Data were analyzed using SPSS software version 25.0 (IBM Corp., Armonk, NY, USA). Results were expressed as mean ± standard deviation (SD). Comparisons between groups were performed using Student's t-test or ANOVA where appropriate. A p-value < 0.05 was considered statistically significant.

RESULTS

Luteinizing Hormone (LH) and Follicle-Stimulating Hormone (FSH) by Age

Serum LH and FSH levels were significantly elevated in patients with alopecia areata compared with healthy controls across all age groups ($p < 0.05$).

- LH: In the 10–20 years group, patients had a mean of 6.66 IU/mL compared with 2.92 IU/mL in controls. In the 21–30 group, 6.96 versus 3.66 IU/mL; in the 31–40 group, 7.07 versus 4.99 IU/mL; and in the 41–50 group, 6.97 versus 4.62 IU/mL.

- FSH: In the 10–20 years group, patients had 6.59 IU/mL compared with 4.50 IU/mL in controls. In the 21–30 group, 7.20 versus 4.56 IU/mL; in the 31–40 group, 7.89 versus 4.99 IU/mL; and in the 41–50 group, 7.96 versus 4.93 IU/mL.

These findings demonstrate consistent elevations of both hormones in all age groups (Table 1, Figure 1A–B).

Table 1: Age distribution of LH and FSH levels

Age Group (years)	LH - Control (IU/mL)	LH - Patients (IU/mL)	FSH - Control (IU/mL)	FSH - Patients (IU/mL)
10–20	2.92	6.66	4.5	6.59
21–30	3.66	6.96	4.56	7.2
31–40	4.99	7.07	4.99	7.89
41–50	4.62	6.97	4.93	7.96

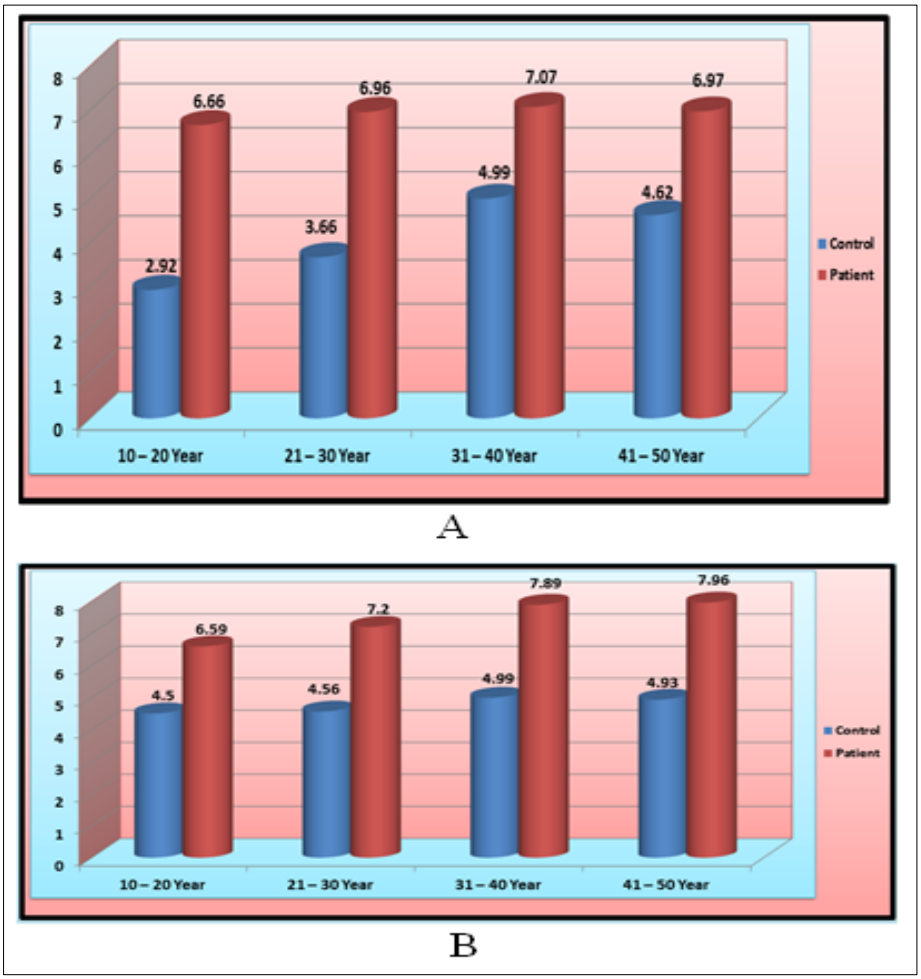

Figure 1: ***Serum hormone levels by age group.*** **(A) Luteinizing hormone (LH) concentrations in alopecia areata patients compared with controls. (B) Follicle-stimulating hormone (FSH) concentrations in alopecia areata patients compared with controls.**

Luteinizing Hormone (LH) and Follicle-Stimulating Hormone (FSH) by Gender
Gender-based analysis also revealed significant hormonal differences.

- LH: Male patients showed higher LH compared with healthy males (7.75 ± 0.55 vs. 6.42 ± 0.34 IU/mL, $p < 0.01$). Female patients also demonstrated significantly elevated LH compared with controls (6.87 ± 0.52 vs. 5.75 ± 0.49 IU/mL, $p < 0.05$).
- FSH: Male patients had higher FSH than controls (8.08 ± 0.73 vs. 6.22 ± 0.40 IU/mL, $p < 0.05$). Female patients exhibited even greater differences (8.84 ± 0.59 vs. 6.85 ± 0.41 IU/mL, $p < 0.01$).

These results indicate a more pronounced hormonal imbalance among female AA patients (Table 2, Figure 2A–B).

Table 2: Gender distribution of LH and FSH levels

Gender	LH - Control (IU/mL)	LH - Patients (IU/mL)	FSH - Control (IU/mL)	FSH - Patients (IU/mL)
Male	6.42	7.75	6.22	8.08
Female	5.75	6.87	6.85	8.84

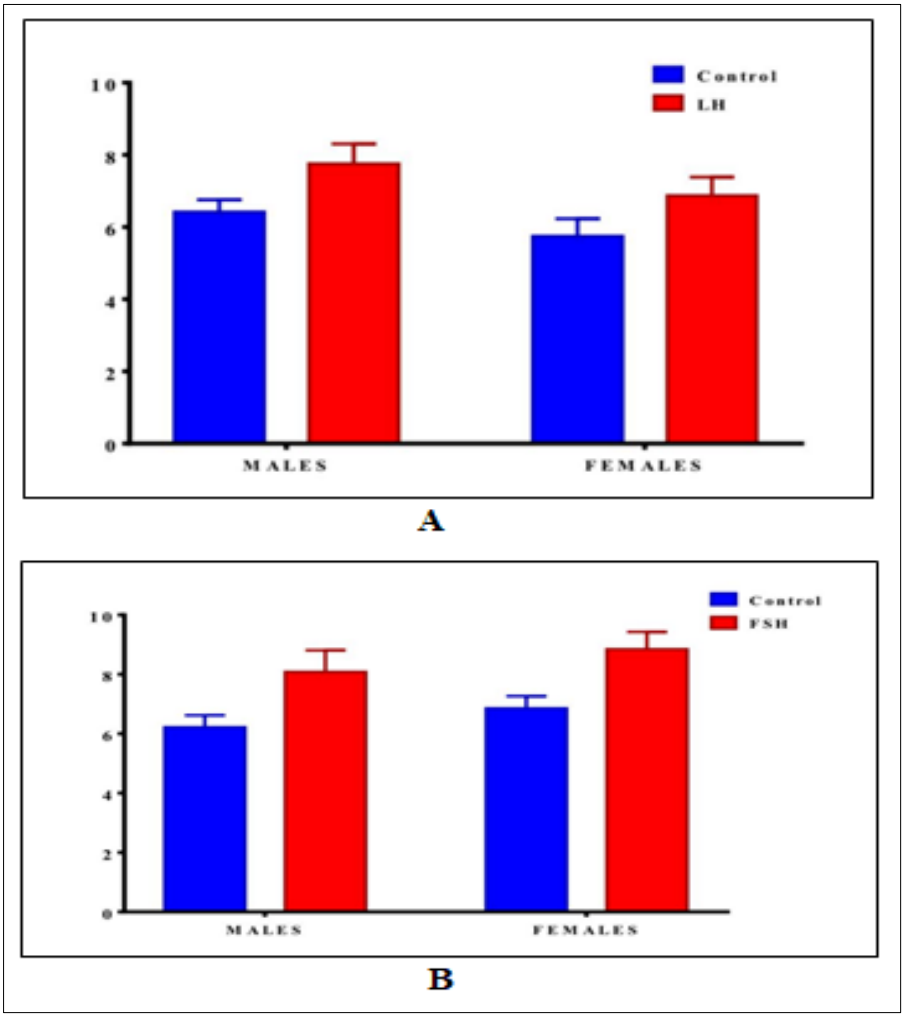

Figure 2: ***Serum hormone levels by gender.*** **(A) Luteinizing hormone (LH) concentrations in male and female alopecia areata patients compared with controls. (B) Follicle-stimulating hormone (FSH) concentrations in male and female alopecia areata patients compared with controls.**

Summary of Findings

- Both LH and FSH were significantly higher in AA patients compared with healthy controls.
- Elevations were consistent across all age groups.
- Female patients exhibited greater increases, especially in FSH, suggesting possible gender-specific hormonal influences in AA pathogenesis.

DISCUSSION

Principal Findings

In this case–control study, patients with alopecia areata (AA) exhibited significantly higher serum luteinizing hormone (LH) and follicle-stimulating hormone (FSH) levels compared with healthy controls across all age groups. Gender-stratified analyses revealed more pronounced FSH elevations in females. These findings suggest a potential endocrine–immune interaction in AA pathogenesis.

Relation to Existing Literature

AA is a prototypical autoimmune hair disorder driven by loss of hair follicle immune privilege and autoreactive T-cell infiltration (Sibbald & Shapiro, 2023; Ma *et al.,* 2025). Recent reviews reaffirm the central role of T-cell–mediated inflammation, while also highlighting the contribution of systemic modifiers such as genetics, microbiome changes, and

hormones (Passeron *et al.,* 2023; Xu *et al.,* 2023; Šutić Udović *et al.,* 2024). Singh *et al*., and Owecka *et al*., reported that sex hormones and gonadotropins significantly influence hair follicle cycling and local immune responses, providing biological plausibility for the current findings.

Our results align with (Ranasinghe *et al.,* 2016), who described androgen excess in a substantial proportion of AA patients, frequently associated with polycystic ovary syndrome (PCOS), a condition characterized by abnormal gonadotropin secretion. A more recent experimental study by[8] demonstrated that LH dysregulation can directly induce hair loss in murine models, lending mechanistic support to our clinical observations. Furthermore (Burma *et al.,* 2025). emphasized the role of cutaneous and gut dysbiosis in AA, suggesting that endocrine and immune disturbances may intersect with microbiome alterations to shape disease expression.

Interpretation

Taken together, these findings support a model where pituitary gonadotropins (LH, FSH) not only regulate reproductive function but may also influence follicular immune privilege and hair cycling. Elevated gonadotropins could exacerbate androgen activity in PCOS-like states, particularly in women, explaining the stronger FSH/LH signals observed in our female cohort. This is consistent with updated reviews highlighting endocrine abnormalities as potential modulators of non-scarring alopecia (Singh *et al.,* 2023; Owecka *et al.,* 2024).

Clinical Implications

Endocrine screening in AA, particularly in female patients with irregular menses, hirsutism, or other hyperandrogenic features, may be clinically valuable. Identifying hormonal imbalances such as elevated LH/FSH could guide comprehensive management, including referrals for PCOS evaluation or endocrine treatment strategies (Ranasinghe *et al.,* 2016; Singh *et al.,* 2023).

Strengths and Limitations

Strengths of this study include its case–control design, age- and sex-stratified analyses, and standardized hormone measurements. Limitations include the single-center setting, relatively small sample size, and lack of adjustment for confounders such as menstrual cycle phase, BMI, insulin resistance, and thyroid status. Future research should integrate hormonal, immunological, and microbiome data to clarify causal links and explore potential therapeutic targets (Ranasinghe *et al.,* 2016; Singh *et al*., 2023; Passeron *et al.,* 2023).

CONCLUSIONS

This study demonstrated that patients with alopecia areata exhibit significantly higher serum levels of luteinizing hormone (LH) and follicle-stimulating hormone (FSH) compared with healthy controls, with a more pronounced elevation of FSH among females. These findings support the hypothesis that endocrine dysregulation, particularly involving pituitary gonadotropins, may contribute to AA pathogenesis alongside immune mechanisms. Routine hormonal screening in selected patients could provide additional insights into disease mechanisms and guide individualized management. Future multi-center studies are needed to validate these results and to explore the interplay between endocrine, immune, and genetic factors in AA.

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