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ASSESSMENT OF IRON STATUS IN FEMALE PATIENTS WITH NON-CICATRICIAL ALOPECIA USING HEMOGLOBIN AND SERUM FERRITIN

Dermatology

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ABSTRACT

Background: Iron deficiency has been implicated as a potential contributor to non-cicatricial alopecia; however, the association between iron status and hair loss remains controversial. This study assessed hemoglobin and serum ferritin levels in female patients with non-cicatricial alopecia. **Methods:** A cross-sectional observational study was conducted among 102 female patients aged ≥18 years with clinically diagnosed non-cicatricial alopecia attending the dermatology outpatient department of a tertiary care teaching hospital between April 2024 and September 2025. Demographic and clinical data were recorded, and laboratory investigations included hemoglobin, serum ferritin, serum iron, total iron-binding capacity, and erythrocyte sedimentation rate. Data were analyzed using IBM SPSS Statistics version 26.0. **Results:** The majority of participants were aged 18–29 years (28.4%). Alopecia areata (39.2%) was the most common subtype, followed by androgenetic alopecia (35.3%) and telogen effluvium (25.5%). The mean hemoglobin level was 11.98 ± 1.39 g/dL, while the mean serum ferritin level was 20.95 ± 14.08 ng/mL. Iron deficiency (serum ferritin <15 ng/mL) was present in 28.4% of patients, and 37.3% had borderline iron stores (15–30 ng/mL). Overall, 50.0% of participants had hemoglobin levels below 12 g/dL, and 32.4% had low serum iron levels. **Conclusions:** A substantial proportion of women with non-cicatricial alopecia had reduced serum ferritin levels and low hemoglobin concentrations. Assessment of serum ferritin and hemoglobin may be useful in the routine evaluation of patients with non-cicatricial alopecia to identify underlying iron deficiency and facilitate appropriate management.

KEYWORDS

Non-cicatricial Alopecia; Serum Ferritin; Hemoglobin; Iron Deficiency; Alopecia Areata; Androgenetic Alopecia; Telogen Effluvium.

INTRODUCTION

Non-cicatricial alopecia is one of the most common dermatological disorders, characterized by hair loss without permanent destruction of the hair follicle, allowing the potential for regrowth. It encompasses several clinically distinct entities, including androgenetic alopecia (AGA), alopecia areata (AA), telogen effluvium (TE), and trichotillomania, each differing in etiology but sharing disruption of the normal hair growth cycle. AGA, the most prevalent form of progressive hair loss, results from follicular miniaturization mediated by increased sensitivity to dihydrotestosterone (DHT), whereas AA is an autoimmune disorder characterized by T-cell-mediated attack on hair follicles. In contrast, TE is frequently associated with systemic or nutritional disturbances, including iron deficiency, thyroid dysfunction, and protein or micronutrient deficiencies.[1–14]

Iron is essential for cellular proliferation, DNA synthesis, and mitochondrial energy metabolism, processes that are critical for the rapidly proliferating matrix cells of the hair follicle during the anagen phase. Serum ferritin, the primary intracellular iron storage protein, is widely accepted as a marker of body iron stores, while hemoglobin reflects the functional availability of iron and provides additional information regarding systemic iron status. Iron deficiency has been proposed to impair normal hair follicle cycling, making ferritin and hemoglobin potential biomarkers in the evaluation of patients with non-cicatricial alopecia.

Previous studies investigating the relationship between iron status and non-cicatricial alopecia have produced inconsistent findings. Several investigators have reported significantly lower serum ferritin levels in patients with AA and AGA compared with healthy controls, suggesting that depleted iron stores may contribute to disease development or severity.[15,16,18–20] A systematic review and meta-analysis involving more than 10,000 women also demonstrated significantly lower serum ferritin levels among individuals with non-scarring alopecia, supporting a possible association between reduced iron stores and hair loss.[18] Conversely, other studies have failed to identify significant differences in serum ferritin or iron levels between patients and controls, indicating that the role of iron deficiency may vary according to alopecia subtype and patient characteristics.[17]

The association between hemoglobin and alopecia has also been explored, although evidence remains limited. Reduced hemoglobin levels have been reported in patients with more severe forms of AGA and TE, while factors such as dietary habits, menstrual status, and vitamin D levels may influence iron biomarkers and should be considered when interpreting these findings.[21–23]

Given the conflicting evidence regarding the association of iron status with non-cicatricial alopecia, further evaluation is warranted. Therefore, the present study aimed to assess serum ferritin and hemoglobin levels in patients with non-cicatricial alopecia and compare these parameters across different clinical subtypes.

MATERIALS AND METHODS

Study design and setting

This cross-sectional observational study was conducted in the Department of Dermatology, Akash Institute of Medical Sciences and Research Centre, Bengaluru, India, over an 18-month period from April 2024 to September 2025.

Study participants

A total of 102 female patients aged ≥18 years with a clinical diagnosis of non-cicatricial alopecia attending the dermatology outpatient department during the study period were enrolled using a convenience sampling method. The inclusion criteria were female patients aged above 18 years with clinically diagnosed non-cicatricial alopecia who provided written informed consent. Patients with active infections or inflammatory conditions, pregnancy, systemic illnesses, scalp dermatoses, current iron supplementation, or medications known to cause hair loss were excluded from the study.

Ethical considerations

The study protocol was approved by the Institutional Ethics Committee of Akash Institute of Medical Sciences and Research Centre. Written informed consent was obtained from all participants before enrolment.

Data collection

Demographic and clinical data were collected using a pretested structured proforma. Information regarding age, duration, pattern and distribution of hair loss, precipitating factors, family history, and associated symptoms was recorded. A detailed scalp examination was performed for all participants, and clinical photographs were obtained after written consent.

Laboratory investigations

Venous blood samples were collected under aseptic precautions for

laboratory analysis. Hemoglobin estimation was performed using a fully automated five-part hematology analyzer (Mindray). Serum ferritin levels were measured using a TOSOH AIA-360 chemiluminescent enzyme immunoassay analyzer. The primary outcome measures were hemoglobin (g/dL) and serum ferritin (ng/mL) levels.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Associations between categorical variables were analyzed using the chi-square test or Fisher's exact test, as appropriate. A two-tailed *p* value <0.05 was considered statistically significant.

RESULTS

A total of 102 female patients with non-cicatricial alopecia were included in the study. The largest proportion belonged to the 18–29-year age group (28.4%), followed by the 30–39 and 40–49-year age groups (21.6% each). Most participants belonged to the middle (33.3%) or upper-middle (29.4%) socioeconomic classes, were from urban areas (70.6%), and were housewives (40.2%) (Table 1).

Among the different types of non-cicatricial alopecia, alopecia areata was the most common diagnosis (39.2%), followed by androgenetic alopecia (35.3%) and telogen effluvium (25.5%). The most frequent subtype was moderate alopecia (28.4%), followed by Ludwig Grade I androgenetic alopecia (24.5%) and acute telogen effluvium (16.7%) (Table 2).

The mean hemoglobin level was 11.98 ± 1.39 g/dL. Mean hematocrit, mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration were 39.3 ± 3.37%, 88.8 ± 3.94 fL, 29.58 ± 1.83 pg, and 31.53 ± 1.45 g/dL, respectively. The mean serum ferritin level was 20.95 ± 14.08 ng/mL, mean serum iron was 76.27 ± 29.79 µg/dL, total iron-binding capacity was 359.76 ± 51.74 µg/dL, and mean erythrocyte sedimentation rate was 10.32 ± 4.06 mm/h (Table 3).

Half of the participants (50.0%) had hemoglobin levels ≥12 g/dL, whereas 25.5% and 24.5% had hemoglobin levels of 8–10.9 g/dL and 11–11.9 g/dL, respectively. No participant had severe anemia (hemoglobin <8 g/dL) (Table 4).

Serum ferritin levels indicated iron deficiency (<15 ng/mL) in 28.4% of patients and borderline iron stores (15–30 ng/mL) in 37.3%, while only 34.3% had normal iron stores. None of the participants had elevated serum ferritin levels (>150 ng/mL) (Table 5).

Low serum iron levels (<60 µg/dL) were observed in 32.4% of participants, whereas 67.6% had serum iron concentrations within the normal reference range. No participant had elevated serum iron levels (Table 6).

DISCUSSION

The present study evaluated hemoglobin and iron status among female patients with non-cicatricial alopecia. The findings demonstrated that the study population predominantly comprised young adults, with alopecia areata being the most common subtype. Nearly two-thirds of the participants had depleted or borderline iron stores, while half had hemoglobin levels below the normal range, suggesting that alterations in iron status are common among women presenting with non-cicatricial alopecia.

The majority of patients in the present study belonged to the 18–29-year age group, with a gradual decline in frequency in older age groups. Similar findings have been reported by Aslam et al.[15], Rani et al.[22], Aejaz Ali et al.[17], Khan et al.[26], and Gangaiah et al.[19], all of whom observed that non-cicatricial alopecia predominantly affects young adults. Babar et al.[25] reported a slightly higher mean age among patients with androgenetic alopecia; however, most participants in their study also belonged to the younger age groups. In contrast, Sambangi et al.[21] reported an older study population, reflecting differences in study design and the alopecia subtypes evaluated. Similar to the findings of Sambangi et al.[21], the present study also demonstrated an urban predominance, which may be attributable to greater healthcare accessibility and increased health-seeking behavior among urban residents.

The mean hemoglobin concentration in the present study was 11.98 ± 1.39 g/dL. Although severe anemia was not observed, half of the participants had hemoglobin levels below 12 g/dL, indicating a high prevalence of mild anemia or borderline hemoglobin levels. Comparable mean hemoglobin values were reported by Aslam et al.[15], whereas lower mean values were observed by Sambangi et al.[21], Pradhan et al.[20], and Gangaiah et al.[19]. Conversely, Aejaz Ali et al.[17] reported no significant difference in hemoglobin levels between patients and controls. These variations may be explained by differences in nutritional status, demographic characteristics, inclusion criteria, and the distribution of alopecia subtypes among study populations.

The present study demonstrated a mean serum ferritin level of 20.95 ± 14.08 ng/mL. Furthermore, 28.4% of participants had iron deficiency and an additional 37.3% had borderline iron stores, indicating that nearly two-thirds of the study population had depleted or suboptimal iron reserves. These findings are consistent with those reported by Aslam et al.[15], who observed significantly lower serum ferritin levels among patients with alopecia, particularly those with alopecia areata and androgenetic alopecia. Similar reductions in serum ferritin have also been reported by Pradhan et al.[20], Khan et al.[26], and Rani et al.[22], supporting an association between reduced iron stores and non-cicatricial alopecia. In contrast, Devaraj et al.[24] and Aejaz Ali et al.[17] reported predominantly normal ferritin concentrations and did not observe a significant association between ferritin levels and alopecia. These conflicting findings may reflect differences in geographical location, nutritional status, laboratory methods, sample size, and the spectrum of alopecia subtypes included in individual studies.

The mean serum iron and total iron-binding capacity observed in the present study were within expected reference ranges for most participants, although approximately one-third had reduced serum iron levels. Similar observations have been reported by Sambangi et al.[21], who found no significant association between serum iron or total iron-binding capacity and alopecia subtype. Collectively, these findings suggest that serum ferritin may be a more sensitive marker of iron deficiency than serum iron alone, as ferritin reflects body iron stores before changes in circulating iron concentrations become apparent.

The findings of the present study support the assessment of iron status, particularly serum ferritin, in women presenting with non-cicatricial alopecia. Identification of depleted iron stores may facilitate appropriate evaluation and correction of iron deficiency in selected patients. However, considering the inconsistent findings reported across the literature, routine iron supplementation should be guided by laboratory evidence rather than empirical treatment.

The present study has certain limitations. It was conducted at a single tertiary care center with a relatively small sample size and included only female patients, which may limit the generalizability of the findings. Furthermore, the absence of a healthy control group precludes definitive conclusions regarding the causal relationship between iron deficiency and non-cicatricial alopecia. Future multicenter studies with larger sample sizes and appropriate control groups are warranted to further clarify the role of iron status in different subtypes of non-cicatricial alopecia and to determine whether correction of iron deficiency influences treatment outcomes.

CONCLUSION

Non-cicatricial alopecia predominantly affected young adult females, with alopecia areata and androgenetic alopecia being the most common subtypes. A considerable proportion of patients had low or borderline serum ferritin levels, and half had hemoglobin levels below the normal range. These findings support the assessment of serum ferritin and hemoglobin as part of the routine evaluation of patients with non-cicatricial alopecia to identify underlying iron deficiency and guide appropriate management.

Table 1. Baseline characteristics of the study participants (N = 102)

Characteristic	Category	n (%)
Age group (years)	18–29	29 (28.4)
	30–39	22 (21.6)
	40–49	22 (21.6)
	50–59	19 (18.6)
	≥60	10 (9.8)

Socioeconomic status	Lower	7 (6.9)
	Lower middle	24 (23.5)
	Middle	34 (33.3)
	Upper middle	30 (29.4)
	Upper	7 (6.9)
Residence	Urban	72 (70.6)
	Rural	30 (29.4)
Occupation	Housewife	41 (40.2)
	Student	19 (18.6)
	Office worker	18 (17.6)
	Skilled labour	12 (11.8)
	Unskilled labour	12 (11.8)

Table 2. Distribution of non-cicatricial alopecia by type and subtype (N = 102)

Variable	Category	n (%)
Alopecia type	Alopecia areata	40 (39.2)
	Androgenetic alopecia	36 (35.3)
	Telogen effluvium	26 (25.5)
Subtype	Moderate alopecia areata	29 (28.4)
	Ludwig Grade I	25 (24.5)
	Acute telogen effluvium	17 (16.7)
	Ludwig Grade II	11 (10.8)
	Mild alopecia areata	11 (10.8)
	Chronic telogen effluvium	9 (8.8)

Table 3. Hematological and iron profile of the study participants

Parameter	Mean ± SD
Hemoglobin (g/dL)	11.98 ± 1.39
Hematocrit (%)	39.30 ± 3.37
Mean corpuscular volume (MCV), fL	88.80 ± 3.94
Mean corpuscular hemoglobin (MCH), pg	29.58 ± 1.83
Mean corpuscular hemoglobin concentration (MCHC), g/dL	31.53 ± 1.45
Serum ferritin (ng/mL)	20.95 ± 14.08
Serum iron (µg/dL)	76.27 ± 29.79
Total iron-binding capacity (µg/dL)	359.76 ± 51.74
Erythrocyte sedimentation rate (mm/h)	10.32 ± 4.06

Table 4. Distribution of hemoglobin levels among the study participants

Hemoglobin (g/dL)	n (%)
8.0–10.9	26 (25.5)
11.0–11.9	25 (24.5)
≥12.0	51 (50.0)

Table 5. Distribution of serum ferritin levels among the study participants

Serum ferritin category	Ferritin (ng/mL)	n (%)
Iron deficiency	<15	29 (28.4)
Borderline/Low iron stores	15–30	38 (37.3)
Normal iron stores	30–150	35 (34.3)
High ferritin	>150	0 (0.0)

Table 6. Distribution of serum iron levels among the study participants

Serum iron category	Serum iron (µg/dL)	n (%)
Low	<60	33 (32.4)
Normal	60–170	69 (67.6)
High	>170	0 (0.0)

FIGURE 1. Alopecia Type

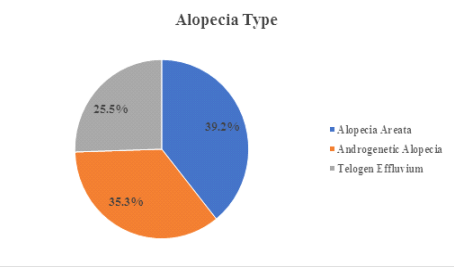


FIGURE 2. Subtype

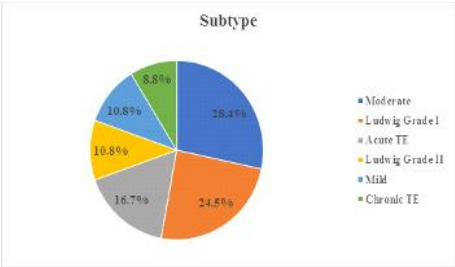


FIGURE 3. Serum Ferritin (ng/mL)

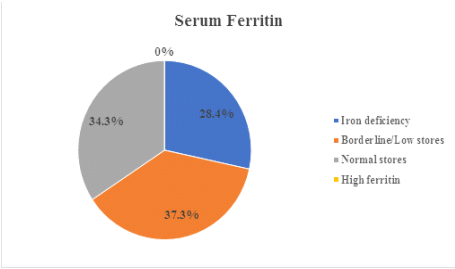
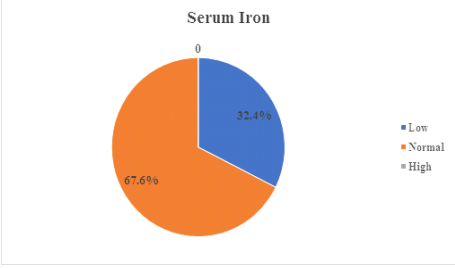


FIGURE 4. Serum Iron (µg/dL)



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