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Original Research Article

Relationship between Body Iron Stores and Non Scarring Diffuse Hair Loss in Non-Menopausal Women: A Case Control Study

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Abstract:

Background: Because iron plays a physiological role in the hair cycle, iron deficiency (ID) may interfere with healthy hair development. Numerous research have looked into the connection between body iron status and hair loss, with varying degrees of success. In order to provide evidence for the significance of iron reserves in non-scarring diffuse hair loss in non-menopausal women, this study was conducted. The purpose of this study is to ascertain how diffuse, non-scarring hair loss in non-menopausal women relates to body iron reserves.

Methods: At GSMCH, Ram Nagar (Rajpura), Patiala, Punjab, from March to November 2023, 40 women aged 15 years or older with diffuse hair loss (Female pattern hair loss (FPHL) / chronic telogen effluvium (CTE)) and 40 controls without any history or physical signs of hair loss participated in this controlled study. All of the subjects' subjective hair loss was assessed using a same questionnaire. Hemoglobin and ferritin levels in the serum were used to evaluate the iron status. Descriptive and inferential statistical analysis using Mean ± standard deviation, Chi-square, Fisher Exact test and Student t test.

Results: Three groups were identified through analysis: "Excessive hair loss" (17.5%), "Moderate hair loss" (82.5%), and "Absence of hair loss" (0%). When comparing the incidence of ID (Serum ferritin <40□g/L and Hb <12gd/L) in nonmenopausal women experiencing diffuse hair loss to controls, which was 22.5% (n = 9), there was a statistically significant increase among the women experiencing hair loss (n = 27).

Conclusion: In non-menopausal women, diffuse hair loss is related to low iron storage. In the treatment of disease, screening to determine these levels in cases of hair loss and supplementing with them when deficient are effective.

Keywords: Diffuse hair loss, Non-Menopausal women, Iron stores, Serum ferritin, Anemia.

Introduction

Women's hair loss is a frequent age-related issue that significantly lowers quality of life. [1] Over 25% of women in developed nations and approximately 50% of women in the US experience hair loss by the age of 502, [3] and 25–30% of Caucasian women are not menopausal. [4]

The majority of non-scarring alopecia in women is caused by three primary types of hair disorders: telogen effluvium, androgenetic alopecia, and alopecia aerate. [1] Only 10–13% of women who do not menstruate have androgenic alopecia, compared to 37% of post-menopausal women. [5] Around 30% of women in the United States, the United Kingdom, and Japan suffer from chronic telogen effluvium. [6] The actual prevalence of hair loss in Indians is not well-documented in the literature. Nevertheless, the 1.7% predicted lifetime prevalence is not a trustworthy estimate. [7] Chronic telogen effluvium, or widespread normal club hair loss, occurs when hair falls for longer than six months following a trigger event (CTE).The gradual widespread hair loss along with front temporal or central scalp thinning is known as the female pattern of hair loss (FPHL). The majority of cases of diffuse non-scarring alopecia are caused by CTE and FPHL, which are serious dermatological issues. [8] Although diffuse non-scarring hair loss may not appear significant to those who are not affected, it has a terrible impact on women's quality of life. [9]

Common triggers for hair loss include pregnancy, illness, and drug use.10 Iron deficiency (ID) has been suggested as one of the potential causes of significant hair loss in women. Nutritional inadequacies have been linked to recurrent hair loss. [11,12.13,14] The body's total iron content is divided into three categories: storage, transit, and functional iron. Iron deficiency anemia (IDA), which is the complete depletion of all body iron, is caused by low transport of iron, which compromises cofactor production and presents with and with-

out anemia. Iron deficiency anemia (ID) is caused by reduced stores of iron. The spectrum of ID and variable effects on each compartment are caused by the reduction of total body iron. The association between iron deficiency (ID) and hair loss is not easily understood. Depletion of tissue iron stores leads to a decrease in ferritin, a secretory form of glycosylated protein in the bloodstream that exacerbates liver disease, cancer, and inflammation. In the absence of chronic illnesses and non-specific inflammation, serum ferritin concentration is therefore considered an early sign of an absence of iron reserves. [15,16]

It is still up for debate if there is a direct correlation, as of yet, between diffuse hair loss and iron storage in nonmenopausal women compared to the normal population. The current study will contribute to our understanding of the characteristics of diffuse hair loss in nonmenopausal women and the potential risk factor associated with iron body storage. Consequently, assist in organizing the treatment plan and laboratory evaluation.

Material and Methods

From March 2023 to November 2023, 40 women in a row with diffuse non-scarring hair loss (CTE/FPHL) presented to the dermatology outpatient department (OPD) at Gian Sagar Medical College and Hospital in Ram Nagar (Rajpura), Patiala, Punjab. Forty age-matched women who did not experience hair loss were included in the study as controls.

Patients who have not reached menarche or who are menopausal, who have systemic diseases (inflammatory ones), diffuse hair loss less than six months, a history of stressful events in the previous six months (such as surgery, prolonged illness, chemotherapy, emotional stress, crash diet, pregnancy), or who have not reached menarche are not eligible.

Every participant was questioned about their medical history, including illnesses, medicine types and dosages and/or changes, menstrual cycles, and pregnancy. Current clinical status was also inquired about, pertaining to the beginning and progression of hair loss. In order to identify any systemic or local dermatological disorder that may be connected to hair loss, both general and local tests were performed. The physical examination and patient history were used to make the diagnosis of diffuse non-scarring hair loss.

A series of descriptive self-assessment questionnaires were used to determine the severity of hair loss. Hairs lost during washing, brushing, towel-drying hair, on the pillow after a night's sleep, and on clothing were used to determine the amount of hair loss. There were three categories for hair shed: none, few, and much.

Serum ferritin, total iron, and total iron binding capacity were all included in the iron profile and full hemogram that were delivered with the blood. A sensitivity of 59% and a specificity of 99% are only obtained from serum ferritin concentrations of 10–15 µg/L, while a sensitivity of 98% and a specificity of 98% are obtained from values of 40µg/L and higher, due to the wide range of ferritin levels used in the literature to define ID. A serum ferritin level greater than 70µg/L is regarded as normal.[4, 17] Therefore, to assess the prevalence of ID in patients and control people, we used three distinct serum ferritin levels in this study: ≤15 µg/L, ≤40 µg/L, and ≤70 µg/L. Anemia is defined as hemoglobin less than 12 g/dL (WHO criteria).

This study included both descriptive and inferential statistical analysis. findings for categorical data are shown in Number (%), while findings for continuous measurements are displayed as Mean±SD. The 5% level of significance is used to determine significance. The significance of research parameters on a continuous scale between two groups on metric parameters was determined using the student t test. In order to evaluate the homogeneity of variance, Leven's test has been conducted. Fisher/Chi-square A precise test to determine the study parameters' significance between two or more groups on a categorical scale.

Results

In this investigation, 40 healthy female controls with ages ranging from 32.18 ± 6.36 to 40 nonmenopausal patients with 80% CTE (n = 32) and 20% FPHL (n = 8), with a mean age of 26.98 ± 7.86 years, were included (Table number 1). A positive family history of hair loss was present in 40% (n = 16) of the patients, which was statistically significant (p = 0.001).

Table 1: Age distribution

Age in years	Cases	Control	Total
11-20	8(20%)	0(0%)	8(10%)
21-30	21(52.5%)	19(47.5%)	40(50%)
31-40	9(22.5%)	16(40%)	25(31.3%)
41-50	2(5%)	5(12.5%)	7(8.8%)
Total	40(100%)	40(100%)	80(100%)
Mean ± SD	26.98±7.86	32.18±6.36	29.585±5.57

P = 0.002, Significant, Student t test**

On assessment, 57.5% of the subjects (n = 23) showed pallor, and 37.5% of the subjects (n = 15) showed hair pull test positivity; these findings were significant (p<0.001 and p<0.001, respectively). Self-assessed questionnaires were used to quantify hair loss, and the results demonstrated a statistically significant difference between cases and controls for hair loss (Table 2).

Table 2: Hair lost distribution in two groups in studied

Hair lost	Cases (n = 40)	Control (n = 40)	Total (n = 80)
During Wash			
• Very few hair or none	0(0%)	27(67.5%)	27(33.8%)
• Few hairs	9(22.5%)	13(32.5%)	22(27.5%)
• Many hairs	31(77.5%)	0(0%)	31(38.8%)
In Towel			
• Very few hair or none	11(27.5%)	28(70%)	39(48.8%)
• Few hairs	28(70%)	12(30%)	40(50%)
• Many hairs	1(2.5%)	0(0%)	1(1.3%)
During Combing			
• Very few hair or none	0(0%)	25(62.5%)	25(31.3%)
• Few hairs	18(45%)	15(37.5%)	33(41.3%)
• Many hairs	22(55%)	0(0%)	22(27.5%)
On pillow after night sleep			
• Very few hair or none	16(40%)	31(77.5%)	47(58.8%)
• Few hairs	22(55%)	9(22.5%)	31(38.8%)
• Many hairs	2(5%)	0(0%)	2(2.5%)
On cloths during a day			
• Very few hair or none	16(40%)	31(77.5%)	47(58.8%)
• Few hairs	16(40%)	9(22.5%)	25(31.3%)
• Many hairs	8(20%)	0(0%)	8(10%)

Chi-Square/Fisher Exact Test P<0.001

On blood sample analysis the following link was noted between hair loss and serum ferritin levels ≤ 15 µg/L, ≤ 40 µg/L, and ≤ 70 µg/L in 27.5%(n = 11), 57.5%(n = 23), 15%(n = 6) respectively in cases (table 3).The mean hemoglobin level was 10.96g/dL, and 12.38 g/dL for control subjects which was statistically significant (p = 0.001) (Table 3). Evaluating for incidence of IDA, Anaemia was noted in concerned 35.7% (n = 10) and 60.7% (n = 17) of women presenting a serum ferritin level lower than ≤15 µg/L and ≤40 µg/L respectively and only one (3.6%) of woman showed anaemia with serum ferritin of ≤70 µg/L.

Which was statistically significant p = 0.004 in comparison to control were only 12 patients presented without anemia with serum ferritin value 8.3% (n = 1), 50% (n = 6), 41.7% (n = 5) respectively (Table 3).

Table 3: Corresponding tabulation between serum ferritin levels (µg/L) and hemoglobulin levels (g/dl)

Serum Ferritin levels (µg/L)	Hemoglobin Levels (g/dl)		Total (n=80)
	<12	>12	
Cases			
• <15.0	10(35.7%)	1(8.3%)	11(27.5%)
• 16-40	17(60.7%)	6(50%)	23(57.5%)
• 41-70	1(3.6%)	5(41.7%)	6(15%)
• >70	0(0%)	0(0%)	0(0%)
• Total	28(100%)	12(100%)	40(100%)
Controls			
<15.0	7(58.3%)	9(32.1%)	16(40%)
16-40	2(16.7%)	13(46.4%)	15(37.5%)
41-70	2(16.7%)	6(21.4%)	8(20%)
>70	1(8.3%)	0(0%)	1(2.5%)
Total	12(100%)	28(100%)	40(100%)

Chi-Square/Fisher Exact Test P<0.004

Figure 1: Chronic telogen effluvium

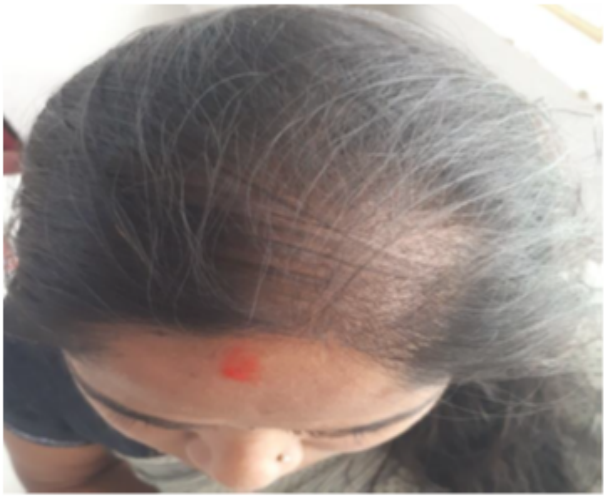

Figure 2: Female pattern of hair loss

Discussion

The present study is the first case control investigation conducted on nonmenopausal women, demonstrating a robust correlation between reduced iron storage and hair loss, specifically non-traumatic diffuse hair loss in nonmenopausal women relative to healthy persons. Our study, which deviated from Whiting DA [18] study (table 1), was mostly focused on young adult age groups 21–30 years old, with n = 21 (52.5%) cases and n = 19 (47.5%) controls. It was statistically significant, with p = 0.002).

The majority of the women in this study had CTE (n = 32), followed by FPHL (20 n = 8). This was different from studies Olsen EA [21] and Kantor J [9] and comparable to prior research by H Rasheed [19] and Raichur SR20. The majority of participants in this study experienced moderate-to-severe hair loss, primarily in CTE (n = 25), followed by FPHL (n = 8). Only CTE (n = 7) experienced excessive hair loss, which was different from the uncontrolled study by Claire Delo1 and Rushton et al. [6], which focused mostly on significant hair loss. The current investigation verifies that women experiencing diffuse hair loss frequently have low ferritin levels, as indicated by ferritin levels of ≤15 µg/L, ≤40 µg/L, and ≤ 70 µg/L in 27.5% (n = 11), 57.5% (n = 23), and 15% (n = 6), respectively, when compared to controls with serum ferritin levels of 40% (n = 16), 37.5% (n = 15), and 2.5% (n = 1), respectively (Table 3).

Our findings concur with those of Rushton11, who found that increased hair shedding required a serum ferritin critical threshold of 40 µg/L. Similarly, two population-based surveys of ID in Iceland (ferritin<12 µg/L) and Canada (ferritin<15 µg/L) reported ID in 5.7% and 30% of menstruating women, respectively, and similarly used a lower ferritin level to define ID. [22,23]

Thus it difficult to interpreting previous study due the variability in data and the control populations used. In 1963 [24], it was proposed that non-

anemic iron deficiency could be the cause of diffuse hair loss in women. However, in the current investigation, anemia was found in 32.1% (n = 9), 46.4% (n = 13), and 21.4% (n = 6) with serum levels of < 15 µg/L, ≤ 40 µg/L, and ≤ 70 µg/L, respectively. This suggests that low iron storage may be a cause in diffuse hair loss in women who are not menopausal, according to a study.

In a study of anemia patients, sideroblast and/or macrophage iron stains were absent from bone marrow aspirates when the serum ferritin level was less than 70µg/L. Therefore, a 99% confidence interval for iron staining in the bone marrow, a substitute indicator of sufficient iron storage, requires a serum ferritin level of greater than 70 µg/L. [25]

Just 16.7% (n = 2) of the control women in the current investigation had iron depleted stores (serum ferritin level < 40µg/l with mean Hb 8.9 g/dl), compared to 60.7% (n = 17) of the 40 cases, which was statistically significant (Table 3).

Therefore, a correlation between anemia and hair loss was seen, primarily when body iron reserves were less than 40µ□g/L. The findings indicated that in nonmenopausal women, low iron reserves (serum ferritin mostly <40µ□g/L and Hb 12g/dL) are substantially associated with the presence of hair loss.

Conclusion

The profile of nonmenopausal women with diffuse hair loss that does not leave scars and lower body storage of iron as a risk factor is better understood thanks to the current study. Planning a course of treatment therefore requires laboratory assessment.

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