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CORRELATION OF SOME BIOCHEMICAL PARAMETERS WITH HAIR LOSS IN ALOPECIA

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Abstract

Background: Hair loss, known medically as alopecia, is a prevalent dermatological issue affecting people globally, recent studies indicate a possible link between various biochemical indicators and the development or progression of this condition. **Objective**: This article aims to provide a comprehensive correlation of biochemical parameters with alopecia such as Hb. RBC, Zinc, Calcium, Iron, Ferritin, folic acid, and thyroid. **Materials and Methods:** Between July and December 2023, a study was undertaken involving 183 patients diagnosed with alopecia areata (80 male and 103 female) while the healthy (control group) were 100 individuals. These patients were randomly selected from outpatient dermatology clinics. Serum samples were centrifuged at 2000 xg for 10 minutes to separate sera to analyze Serum Iron, ferritin, calcium, VitD, VitB12, folic acid, and TSH. Zinc. **Results**: the general hematological parameters comparison between alopecia patients and control groups does not show any significant correlation (Hb and RBC), however, there was an important correlation between male and female patients (females show lower levels than males), the biomarkers comparison shows a significant correlation with (p-value$\leq$0.06) particularly in iron, ferritin, folic acid, zinc, calcium, vitamin D, B12, and thyroid. Females do not show a significant correlation between B12, zinc, and alopecia. **Conclusions**: Hb and RBC do not correlate with alopecia. Vitamin D, Calcium, Iron, and Ferritin significantly correlate with alopecia in both genders. Zinc, B12, folic acid, and TSH correlate with alopecia in males but not females. Only Iron and Ferritin differ significantly between male and female alopecia patients.

Keywords: Alopecia, ferritin, iron, folic acid, vitamin D, Zinc

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Introduction

Alopecia, a medical term denoting the loss of hair or baldness, can occur in various forms and affect different areas of the body. Still, it is most commonly associated with the scalp. Alopecia comprises several types, which can be categorized into distinct groups that can be classified as the following [1, 2]:

- **Androgenetic Alopecia:** This is the most widely recognized sort of hair loss and is frequently inherited. It occurs in both men and women and is characterized by a gradual thinning of hair on the scalp [3].
- **Alopecia Areata**: This is an autoimmune disorder in which the immune system mistakenly attacks hair follicles, leading to hair loss in small, round patches. It can affect the scalp or other areas of the body [4].
- **Alopecia Totalis**: In this form, there is a total loss of hair on the scalp [4].
- **Alopecia Universalis**: This is the most severe form, resulting in the loss of all body hair, including eyebrows and eyelashes [4].
- **Telogen Effluvium**: This type of hair loss occurs when a significant number of hair follicles shift into the telogen (resting) phase of the hair growth cycle prematurely, leading to excessive shedding [5].
- **Traction Alopecia**: Caused by constant pulling or tension on the hair, often due to hairstyles like tight ponytails, braids, or extensions [6].

Simakou et al., 2019 [7] find that alopecia areata induces hair loss through the presence of lymphocytic infiltrations surrounding the hair follicles and the action of IFN-γ. Additionally, individuals with alopecia areata exhibit the presence of IgG antibodies targeting the cells of the hair follicles [7]. However, Alopecia is a condition characterized by the immune system mistakenly attacking hair follicles, leading to hair loss. This autoimmune disorder can result in varying degrees of hair loss, ranging from small, round patches to complete loss of hair on the scalp or body. The exact cause of alopecia is not fully understood, but it is believed to involve a combination of genetic, environmental, and immunological factors [8].

A study carried out by Waśkiel-Burnat et al., 2022 [9] suggested that lipocalin-2 and insulin may serve as biomarkers in alopecia areata, with a positive correlation between insulin, HOMA-IR, and the number of hair loss episodes, additionally, adiponectin has been proposed as a novel biomarker of disease severity in alopecia areata. These findings contribute to a better understanding of the systemic nature of alopecia areata and may have implications for its diagnosis and treatment [10, 11].

Although the investigation into the role of vitamins as biomarkers in alopecia isn't as thorough as that of other factors, evidence indicates that specific vitamins may contribute to the onset and advancement of alopecia, among these vitamins is vitamin D (VD). Multiple investigations have proposed a potential correlation between insufficient vitamin D levels and different types of alopecia, such as alopecia areata and androgenetic alopecia. Hair follicles contain vitamin D receptors, and vitamin D is recognized for its role in regulating the immune system, which is involved in the development of alopecia areata [12, 13, 14].

Also, Vitamin E acts as an antioxidant, potentially shielding hair follicles from damage caused by oxidative stress. Certain studies propose that supplementing with vitamin E could enhance hair growth and diminish hair loss [15, 16], in addition, other vitamin deficiencies may play important roles in alopecia such as vitamin A [17], vitamin B12 [18] and vitamin C [19]

The current research aimed to study the correlation between alopecia and some biomarkers, among them Hb, RBC, Ferritin, Iron, Vitamin D, vitamin B12, and Calcium.

Materials and Methods

Study Design

The study was conducted from July 2023 to December 2023 including 183 patients with alopecia areata (80 male and 103 female), randomly recruited from outpatient dermatology clinics. Fasting blood tests were drawn from all members. Seven milliliters of blood samples were obtained from patients by venipuncture and Two milliliters were collected and kept in an EDTA tube for a complete blood picture using the Auto Hematology Analyzer instrument; five milliliters were left for 20 minutes at room temperature. After coagulation, sera were separated by centrifugation at 2000 xg for 10 minutes for Serum Iron, ferritin, calcium, VitD, VitB12, folic, and TSH. The concentration of zinc levels was determined using the uv-v spectroscopy method. Serum Iron, ferritin, and calcium were measured using Cobas C311 while Vitamin D, Vit B12, folic, and TSH, were measured using Cobas e411.

The study excluded participants who were using nutritional supplements and had other systemic illnesses or infections, and positive C-reactive protein as inflammatory conditions may falsely raise serum ferritin [20], Patients suffered from chronic illness including liver disease, diabetes, or any disease that may interfere with this study and Patients had anemia due to other causes. The data obtained could be analyzed using SPSS version 26 and Microsoft Excel 2016. Numeric data were expressed as mean ± SD. The probability $P< 0.05$ = significant, $P> 0.05$ = non.

Statistics

SPSS version 26 was used for the statistical analysis of the data (P-Value ≤ 0.05)

Results

Table 1 shows the analysis of Hematological Parameters in Alopecia Areata Patients Compared to Controls

Table 2 shows the comparison of select biomarkers between the control group and patients with alopecia areata

Table 3 represents the comparison of select biomarkers between males of the healthy group and male patients with alopecia areata

Table 4 indicates a comparison of certain Biomarkers between females of the healthy group and female patients with Alopecia Areata

Table 5 depicts the comparison of hematological parameters and other biomarkers between males and females with alopecia areata respectively.

Table 1: Comparison of hematological parameters between control and patients with alopecia areata

Parameters	Means ± SD		P value
	patients group N=183	Control group N=100	
Hb (mg/dl)	13.10±2.08	13.79±1.62	0.06
RBC ($10^{\wedge 6}$/µl)	4.67±0.52	4.65±0.37	0.781

Table 2: Comparison of some biomarkers between control and patients with alopecia areata

Parameters	Means ± SD		P value
	Patient group N=183	Control group N=100	
Vit D (ng/ml)	18.12 ±26.20	41.04±5.54	< 0.001
Calcium (mg/dl)	8.40±1.14	8.73±0.37	< 0.001
Zinc (µg/dl)	44.56±31.25	85.82 ±10.83	0.06
Vit B12 (pg/dl)	346.83±132.83	322.72±136.89	0.412
Folic acid (ng/ml)	3.55±3.56	3.36±0.42	0.613
Ferritin (ng/ml)	53.8±77.62	113.58±68.33	< 0.001
Iron (µg/dl)	71.23±39.90	125.2±49.84	< 0.001
TSH (µUI/ml)	1.79±1.00	2.04±1.09	0.079

Table 3: Comparison of some biomarkers between males of control and patients with alopecia areata

Parameters	Means ± SD		P value
	Patient group	Control group	
Vit D (ng/ml)	24.54 ±38.70 N=80	40.29 ±5.42 N=45	< 0.001
Calcium (mg/dl)	8.59 ±1.05	8.70±0.31	< 0.001
Zinc (µg/dl)	56.19±29.96	86.36 ±10.53	< 0.001
Vit B12 (pg/dl)	361.25±140.76	355.22 ±136.89	< 0.001
Ferritin (ng/ml)	110.75±94.54	123.46±67.22	< 0.001
Iron (µg/dl)	92.36±39.30	128.64±49.40	< 0.001
Folic acid (ng/ml)	3.64±3.16	3.42±0.37	< 0.001
TSH (µUI/ml)	1.96±1.17	2.06±1.03	< 0.001

Table 4: Comparison of some biomarkers between female control and patients with alopecia areata

Parameters	Means ± SD		P value
	Patient group N=103	Control group N=55	
Vit D (ng/ml)	14.42±10.68	41.65±5.61	< 0.001
Calcium (mg/dl)	8.43±0.99	8.75±0.30	< 0.001
Zinc (µg/dl)	56.47±29.16	85.83 ±11.15	0.06
Vit B12 (pg/dl)	340.47±136.89	338.26±134.0	0.765
Ferritin (ng/ml)	11.31±13.70	28.12±12.45	< 0.001
Iron (µg/dl)	51.09±29.30	122.51±50.48	< 0.001
Folic acid (ng/ml)	3.62±4.11	3.32±0.455	0.590
TSH (µUI/ml)	1.62±0.75	2.03±1.14	0.678

Table 5: Comparison of some biomarkers between males and females in alopecia areata

Parameters	Means ± SD		P value
	Male groupN=80	Female groupN=103	
Hb (mg/dl)	14.85±1.07	11.59±1.53	< 0.001
RBC($10^{\wedge 6}$/µl)	5.10±0.34	4.33±0.39	< 0.001
Vit D (ng/ml)	24.54±38.7	8.43±0.99	0.012
Calcium (mg/dl)	8.59±1.05	11.59±1.53	0.276
Zinc (µg/dl)	56.19±29.96	56.47±29.16	0.949
Vit B12 (pg/dl)	361.25±140.76	340.74±136.89	0.322
Ferritin (ng/ml)	110.75±94.54	11.31±13.7	< 0.001
Iron (µg/dl)	92.36±39.30	51.09±29.30	< 0.001
Folic acid (ng/ml)	3.64±3.16	3.62±4.11	0.964
TSH (µUI/ml)	1.966±1.17	1.62±0.75	0.017

Discussion

Biomarkers play a crucial role in understanding the pathophysiology, activity, and severity of alopecia areata (AA). Various studies have identified and confirmed several biomarkers associated with AA [21].

Table 1 doesn't show significant differences in Hb and RBC between alopecia patients and the control group (healthy individuals) in the current study, the p-values were 0.06 and 0.781 respectively, this finding is the same findings of a study carried out by Yousefi et al., 2014 [22] who mentioned that RBC is negatively correlated with AA, however, Salinas et al., shows significance only in women (Table 5) which indicates that values of Hb and RBC are lower in women than men with p-value lower than 0.001 for both.

Vitamin B12 and Vitamin D deficiencies have been associated with hair loss, specifically alopecia areata (AA). Studies have shown a significant inverse correlation between serum vitamin D levels and the severity of AA, indicating that low vitamin D levels may exacerbate the condition [23, 24], these findings match with the current research finding by which the values of vitamin D in patients and control groups were 18.12 ±26.20 and 41.04±5.54ng/mL respectively, with a significance p-value (lower than 0.001), while vitamin B12 doesn't show any significance between patients and control group (p-value = 0.412), however, there is a significant change in B12 level only in men (p-value≤0.001), while it is 0.765 in females indicates nonsignificant changes in its level. (Tables 3 and 4).

In the current study iron shows a significant correlation with alopecia (p-value ≤ 0.001), while zinc does not show any important correlation (p-value≤0.06), this is math with the results of Dhaher et al., (2018) [25] who mentioned that zinc levels were observed in patients compared to normal individuals with no important difference [25]. In current research, calcium shows an important correlation with alopecia between patients and control groups (p-value ≤ 0.001), as depicted by Mady et al., 2016 who mentioned that a Vitamin D-deficient/low-calcium diet leads to transient noncicatricial alopecia [26]. However, in the current

study, calcium shows a significant correlation in females rather than males (tables 3 and 4).

Studies have shown a correlation between serum ferritin levels and alopecia in women. Lower serum ferritin levels have been associated with various types of alopecia, including androgenetic alopecia and alopecia areata (AA) [27, 28], this finding matches with the results in this study that shows a strong difference between patients with alopecia and control group (11.31±13.70 and 28.12±12.45ng/mL) respectively with (p-value≤0.001) in females (table 4), and also in males as depicted in Table 3.

Folic acid, also known as vitamin B9, is an essential nutrient that plays a crucial role in various bodily functions, including cell division and the formation of DNA. While there is limited direct research on the relationship between folic acid and alopecia (hair loss), some studies suggest that folic acid deficiency may contribute to certain types of hair loss. Folic acid is involved in the synthesis of DNA and RNA, which are essential for cell division and tissue growth, including hair follicles. Adequate levels of folic acid are important for healthy hair growth. However, although rare, folic acid deficiency can lead to various health issues, including hair loss. Research published in the American Journal of Clinical Nutrition suggests that deficiencies in certain B vitamins, including folic acid, may contribute to hair loss or impaired hair growth [29, 30]. The finding of the current manuscript shows a significant correlation between male and alopecia patients and no correlations in female groups (tables 3 and 4).

A correlation exists between Thyroid thyroid-stimulating hormone (TSH) levels and alopecia. Research studies have shown that thyroid dysfunction, including hypothyroidism and hyperthyroidism, can lead to various types of alopecia such as diffuse alopecia, alopecia areata, and androgenetic alopecia [31]. Changes in thyroid hormone levels can impact hair growth and quality. For instance, hypothyroidism can cause hair loss, dryness, and brittleness, while hyperthyroidism may lead to fine, silky hair and diffuse non-scarring alopecia [32,33]. Patients with alopecia areata have an increased risk of autoimmune conditions like thyroid disease. Screening for thyroid dysfunction in patients with alopecia is recommended when there are clinical suspicions or symptoms related to thyroid disorders, however, the current study shows a significant correlation between TSH and alopecia in males and not in females (tables 3 and 4).

Alopecia, a common dermatological condition characterized by hair loss, affects individuals worldwide and can have significant psychological and emotional impacts. While the etiology of alopecia is multifactorial, involving genetic, hormonal, environmental, and immunological factors, emerging research suggests a potential correlation between various biochemical parameters and the onset or progression of alopecia.

Conclusions

- Hematological parameters (Hb and RBC) do not show a correlation with alopecia.
- Vitamin D, Calcium, Iron, and ferritin show a significant correlation with alopecia in both genders (males and females).
- Zinc, B12, folic acid, and TSH do not correlate with alopecia in females, but they show an important link between males and alopecia.
- Comparing females with males alopecia patients, only iron and ferritin show significant differences.

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Ethical Approval:

This research has the approval of the Research Ethics Committee from the Department of Scientific Affairs at the College of Medicine / Al_Iraqia University

Conflict

No conflict of interest.

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List of Abbreviations

EDTA	Ethylenediaminetetraacetic acid
Hb	Haemoglobin
RBC	Red Blood Cell
SD	Standard division
SPSS	Statistical Package for the Social Sciences
TSH	Thyroid Stimulating Hormone
Vit B12	Vitamin B12
Vit D	Vitamin D

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