The Significance of Serum Ferritin and vitamin D Levels in Females Patients with Chronic Telogen Effluvium

Rana Talib Naser[1], Qayssar Joudah Fadheel[2], Ali Hatem Hafedh[3]

[1]Senior of Dermatology, at Al-Imam Al-Sadeq Teaching Hospital/ Babylon Health Directorate, [2]Associate Professor, University of Kufa, Faculty of Pharmacy , Department of Pharmacology and Toxicology, Iraq, [3]Consultant of Dermatology Dr .at Al-Kindy Teaching Hospital/Al-Resafa Health Directorate, Baghdad

Abstract

Back ground : Diffuse hair loss is a very common complaint usually occurs without inflammation or scarring .The loss affects hairs throughout the scalp in a more or less uniform pattern **.** That is characterized by the ingress of a large number of hairs prematurely into telogen phase resulting in diffuse hair shedding at one time often with an acute onset so named acute telogen effluvium .A chronic form with a more insidious onset and a longer duration also exists called chronic telogen effluvium which primarily affects women between the ages of 30 and 60 years and is a diagnosis of exclusion and can cause a great psychological impact on the life of the affected person.

Objective: Measurement the level of serum ferritin and the level of serum vitamin D In adult females with chronic telogen effluvium in order to validate their role in the process of hair loss .

Patients& Methods : This cross-sectional study was conducted at the outpatient Department of Dermatology and Venereology in Al-kindy Teaching Hospital between March and November 2017.Sixty adult Female at age (12 to 52 years) with hair loss in the form of CTE otherwise they are healthy and sixty adult healthy with same age-matched female with no hair loss were included in the study. Diagnosis was based upon clinical examination as well as hair pull test. Serum ferritin and vitamin D levels and Hemoglobin were determined for each participant **.**

Results : Hair loss can have an emotional impact on patients leading to anxiety and frustration. Therefore, diagnosing the underlying etiology is necessary for the better management of the disorder The results of this study suggest that the reduced hair density seen in CTE may possibly be associated with low serum levels of ferritin and vitamin D. It is recommended that hemoglobin level measurement should not be solely relied on in the assessment of hair loss, as it was not significantly different between patients with CTE and controls as seen in our study.

Conclusions: The female cases in this study had significantly low levels of serum ferritin and vitamin D than controls .Our study highlights the importance of serum ferritin and vitamin D evaluation in case of diffuse hair fall.

Keywords:- *serum ferritin , vitamin D , chronic telogen effluvium ,hair loss , female*

Introduction

The hair is the keratinized output of the hair follicle. Significant metabolic efforts are needed for hairs production .Solo, on the scalp emerge 100,000 hairs at the daily rate of growing (0.37- 0.40) mm, this desired a precise tuned nutritional, hormonal, and vascular mutual actions so assortment of systemic diseases will cause aberrations in hair growth(1) . Telogen effluvium (TE) is the widespread form of diffuse non scarring alopecia in women(2) . It is recognized by the premature entrance of a large number of hairs into telogen phase resulting in diffuse hair shedding at one time(3) often with an acute onset and usually taking less than 6

months duration so named acute telogen effluvium (ATE) . A chronic form with a more insidious onset and a longer duration also exists [4,5,6,7] that so called chronic telogen effluvium (CTE) which primarily affects females range in ages between 30 and 60 years and is a diagnosis of exclusion [8] . Treatment for TE is primarily reassurance and counseling. If attempts at identifying a specific cause have been fruitful, one should correct them. A prospective observation and management are usually suitable as shedding is expected to reduce within 3-6 months and there after recuperation should be complete[9,7]. The patient needs a compact discussion clarify the diagnosis and treatment choices. Being a cosmetic concern, the degree of disability due to hair loss varies widely[10]. Psychosocial counseling has been claimed to be the best treatment as it is the safest and least invasive way to address the psychosocial impact [7]. Based on the pathogenesis of TE potential therapeutic options include inhibition of catagen (so as to prolong anagen); induction of anagen in telogen follicles; or inhibition of exogen (to reduce hair shaft shedding) [11]. Neither of the presently available FDA approved standard hair drugs finastetride and minoxidil are highly efficient catagen inhibitors or anagen inducers[11]. However, what can assuredly be done is the exclusion of catagen-inducing drugs (e.g beta-blockers, retinoid, anticoagulants, or antithyroid drugs) or catagen-inducing endocrine disorders (thyroid dysfunction, hyperandrogenism, or hyperprolactinemia).replacement remedies for catagen promoting deficiencies like those of zinc, iron can also be started[12,7]. If there is a measurable deficiency such as IDA, then its replacement may help. anyway, a balanced food and stable body weight are most serious measures[10]. Controlled studies regarding the effectiveness of iron therapy on the result of TE are also deficit, although some benefit has been claimed[3]. It has been suggested that maintaining serum ferritin above 40 ng/dL[12] (70 ng/dl by some authors[13] helps reverse hair loss. An adequate dietary intake and, if required, ferrous sulfate orally at does 300 mg (60 mg elemental iron) taken 3-4 times daily is a broadly consent and cost effective initial therapy[14,15,16].It should lead to rise in hemoglobin concentration by 2 g/dL in 3-4 weeks[16,17]. In cases with poor response causes like misdiagnosis, malabsorption , poor compliance coexisting anemia, and continued blood loss must be assessed[16,17]. Iron supplementation needs to be lasting for 3-6 months till iron stores are replenished[15,16,17,18]. Iron supplementation for long-term unnecessary can cause iron overload[18].The proposed role of antioxidants or other supplements has not been proven by any creditable evidence . No especial therapeutic procedures could prevent stress-enhanced premature onset of catagen is currently available for stress-induced TE[19]. Topical minoxidil could be a reasonable candidate drug in this category as it is known to prolong anagen[20]. In addition, *in vivo* studies in mice have demonstrated that minoxidil can down regulate stress-induced hair growth inhibitory and catagen promoting changes along the "brain-hair axis "[21,22]. Its clinical efficacy in humans with respect to TE remains to be investigated. In addition, stress-coping strategies may help however, controlled data in this respect is lacking. Complex comprehensive, and accurate management addition to drug therapy so as to alleviate clinical symptoms and the concurrent psychological implications may go a long way in helping the patients[23] .

Patients , Materials and Method

Patients

This is a prospective cross sectional study that was conducted in Baghdad at dermatology outpatients clinic in Al-kindy Teaching Hospital between March and November 2017 .

Description of study

60 adult healthy female complaining of hair fall of more than 100 strands per day (self-rated) for more than 6 months were included as cases (patients group) and another 60 adult healthy female without hair loss was included as controls(control group).

Inclusion and Exclusion criteria

Inclusion criteria:- included adult healthy women suffering from hair loss for more than 6 months and should meet the following diagnostic criteria(negative family history , diffuse hair loss in scalp appearance , absent bitemporal recession , absent miniaturized hair , positive hair pull test) .

Exclusion criteria :- included

1- patients not have diagnostic criteria .

2-there are systemic disease and or scalp disease that could be lead to hair loss.

3-Patients on medications that might be implicated to hair loss (e.g antithyroid, anticoagulants, anticonvulsants , retinoid , antihypertensive , or antidepressants) .

4-Individual taking drug containing vitamin D , iron , dietary supplementations .

5-newly stressful conditions during the last 6 months like physiological stress , high fever ,surgical trauma , chronic systemic disease ,bleeding pregnancy ,delivery ,emotional stress or patient has high CRP equal or more than 4 .

Apparatus and Equipments used in the study

Apparatus (Enzyme Linked Immunosorbent Assay/ ELIZA/ , Centrifuge) .Equipments (test tube , pipette , dropper)

Study groups

Group I :- control group (60 adult healthy female without hair loss)

Group II:- patients group (60 adult healthy female with hair fall for more than 6 months)

All the following parameters were measured for study groups which are

1-Serum ferritin 2-Serum vitamin D 3- Hemoglobin

Approval and Ethical aspects -

The procedure and the purpose of study were explained to all patients and advice on specific care and treatment also given to them .

Data Collection :-

The method of collecting information depend on direct interview in dermatology outpatients clinic , The data were collected through a self-administered questionnaire which consisted of three sections: Section A consisted of sociodemographic details, Section B included the questions regarding the factors effecting hair loss, and Section C included laboratory reports specifying serum ferritin and vitamin D level and hemoglobin in the participants. Data were collected from the patient in organized fashion and individually .The interview lasted for (15) minutes in which general and scalp examination were carried out in order to detect any scalp abnormalities and to recognized the type in addition to the pattern of hair loss , knowing that the data collection from Sunday to Wednesday from every Week , begin 8:30 am and continue until 2:00 pm .

procedure for measurement

The serum ferritin and vitamin D levels were assessed by collecting blood samples (both cases and controls) by venepuncture of the large antecubital vein. At room temperature a venous blood sample (5 ml) was allowed to clot and for 10 minute was centrifuged at 10,000 rpm. till the time of the assay serum was stored in two aliquots at –20 C. ferritin was valued by enzyme solid-phase immunometric assay (ELISA) using a kit. 25(OH)D3 was measured by competitive enzyme-linked Immunosorbent assay kit . Samples were precipitated with precipitation reagent to extract the analyte because in vivo all circulating 25(OH)D3 was bound to vitamin D-binding protein .

Statistical analysis Descriptive statistics : use table and figures .Microsoft excel version10

For measurement :use mean and standard deviations. Statistical package :was perform by using SPSS version 17 for windows .Inc. in all tests ,P-value of less than 0.05 was considered to be statistically significant

Results

The study groups consisted of 120 female divided into two groups. 60 adult woman with TE compeers with 60 adult healthy woman with no TE . The mean age of the study groups was 32.6 years (SD ± 6.47) for patients group, and the mean age for control group was 41.3years (SD ± 4.59) , the age distribution was similar across the cases and controls. Among the study groups, the range of age in years with numbers of patients and controls ,can be demonstrated in table (1) .

Table(1) :- Age groups for patients and control

Age group(years)	Patients no.=60 (%)	Control no.=60 (%)
12-19	8 (13.3)	6 (10)
20-29	14 (23.3)	12 (20)
30-39	30 (50)	13 (21.6)
40-49	6 (10)	17 (28.3)
50-59	2 (3.3)	12 (20)

All females were clinically evaluated and doing laboratory blood tests at least once for serum ferritin level, vitamin D concentration and hemoglobin level. A serum ferritin level of less than 30 ng/ml was taken as very low, less than 70ng/ml as low and more than or equal to70ng/ml as normal in both cases and controls . Both groups were categorized for SFL using a cut-off point of 70 ng/mL as the acceptable lowest normal value. The SFL for 44 patient that constitute 73.33% of all patients was very low, while 10 patients which form 16.66% had a low level and 6 patients that form the 10% of all patients at normal level. For the controls cases, the SFL for 8 individual that constitute 13.33% was very low , while 28 individual which form 46.66% had a low level and 24 individual that form the 40% of all at normal level.

The correlation between study groups and SFLs can be clarify in table 2

Table(2) :-Serum ferritin levels in patients group and control group

Serum ferritin level ng/ml	Patients no.= 60 (%)	Control no.= 60 (%)
Very low = less than 30	44 (73.3)	8 (13.3)
Low = 30-70	10 (16.6)	28 (46.6)
Normal = more than or equal to 70	6 (10)	24 (40)

The SFLs in patients ranged (1.53 –89.2) ng/ml and for controls (9.18–103.67) ng/ml. The correlation between range of age in years and the corresponding mean of serum ferritin in study groups will lightened in Table 3

Table(3):- mean of serum ferritin in study groups and related age range

Age range (years)	Mean serum ferritin in patients(ng/dl)	Mean serum ferritin in control(ng/dl)
12-19	15.12	22.8
20-29	10.98	24.3
30-39	14.2	25
40-49	22.5	24.8
50-59	27	29.5
	Mean ± SD 16.672 ± 17.83	Mean ± SD 48.453 ± 187.46

The mean SFL was 16.672 ng/ml among TE patients compared with 48.453 ng/ml for controls. This difference was statistically significant (P= 0.0257) This means that there was an connection between low SFLs and CTE, which may be clinically significant.

The hemoglobin value in patients and controls ranged (10.3–14.10) g/dl and (10.50–16.10) g/dl respectively. Mean hemoglobin level was 11.36 g/dl among TE patients compared with 11.87 g/dl among controls. This difference was statistically insignificant (P=0.0581). A vitamin D level of less than 20 ng/ml was taken as deficiency ,level range (20-29) ng/ml as insufficiency and equal to or more than 30 ng/ml as normal in both cases and control .the two groups were categorized for VDL using a cut-off point of 30 ng /ml as the acceptable lowest normal value. The relation between study groups and serum VDL shown in table 4

Table(4):-Serum vitamin D level in patients and control groups

Serum VDL ng/ml	Patients no.= 60 (%)	no.= 60 (%) Control
Deficit < 20 ng/ml	8 (13.3)	13 (21.6)
Insufficient 20-29 ng/ml	46 (76.6)	22 (36.6)
Sufficient ≥ 30 ng/ml	6 (10)	25 (41.6)

The mean VDL have been compared among the cases and control and the related range of age as in table 5.

Table(5):-VDL for the cases and controls and the related range of age

Age range (year)	Mean serum VDL in patients(ng/ml)	Mean serum VDL in controls (ng/ml)
12-19	19.24	25.4
20-29	13.48	26.3
30-39	20.93	27
40-49	22.8	27.5
50-59	27.5	30.5
	Mean serum VDL ± SD 20.136 ± 7.24	Mean serum VDL ± SD 36.132 ± 22.46

Among the study groups , 13.33% cases had vitamin D deficiency compared to 21.66% of controls. 36.66% of the controls were in the vitamin D insufficiency category compared to 76.66 of patients. 10% of the patients had normal vitamin D values, whereas 41.66% controls fell in the normal category. The Mean VDLs in patient were 20.136 versus 36.132 in controls .On comparing the mean vitamin D values among cases and controls, their difference was found to be statistically significant (P = 0.018).

The means of age, hemoglobin value, SF and vitamin D Levels for patients and controls with their respective ranges are highlighted in Table 6.

Table(6):- the distribution between mean parameters with their ranges and study groups

Mean parameter	Patients	Control
Age	32.6 (13-51)	41.3 (15-52)
Hb	11.36 (10.3-14.1)	11.87 (10.5-16.1)
Mean SF	16.672 (1.53-89.2)	48.453 (9.18-103.67)
Mean VDL	20.136 (11.7-87.4)	36.132 (16.83-91.65)

Discussion

The out comes from this study proposed that the decreased hair density seen in CTE may conceivable be associated with decrease serum values of ferritin and vitamin D. Our study groups consisted of equal number of cases (having hair fall of more than 100 strands per day) and controls with no hair loss . This study involved only females aged 12–52 years old, that is analogous with another study[12]. Approximately 50% of the patients in our study with TE were old 30–39 years , probably because the females at this age are more interested about hair fall. In this study we attempt to prohibit all other reasons that may be related to hair loss by dependent on the exclusion criteria in order to be able to concentrated on the effect of the serum ferritin and vitamin D values on hair loss . we employed many methods involving taking a careful history, replaying of a questionnaire, a clinical examination, hair pull test, to emphasize right selection of patients. Patients were chosen from one clinic (Dermatology Outpatient s Clinic) favoring subjects with the same socioeconomic conditions, traditions and culture. It is remarkable to mention that the CBC may be within normal values in females with mild iron deficiency and TE because of low iron stores in the body will cause hair falling before the evolution of microcytic anemia [24]. Thus, measurements of hemoglobin cannot recognized patients with reduced iron stores[25]**.** Advising that should not depend on hemoglobin values alone in the evaluation of TE, as its not significantly different among patients have CTE and controls as seen in our study. The mean difference in SFL was statistically significant (P value < 0.05) between patients and controls .About 10% of patients with TE had ferritin concentration more 70 ng/ml. This default of a reduced ferritin value in patients with TE may be related to multifactorial etiologies .Rapid reduction in body weight , drugs, fever, and many other factors result in TE. Most of the120 individuals had very low serum ferritin concentration, where as just 25 % of the study groups had ferritin values more than 70 ng/ml. This results may be related to increased incidence of iron deficiency in the Iraqi population also due to the fact that IDA is obvious among adult non-pregnant healthy females in addition to an insufficient iron intake and so much consumption of tea and coffee by adults during on the day time predominately after meals prohibit the absorption of iron[26].in addition the menstruating women are more susceptible to iron deficient than postmenopausal women[25,27] Serum ferritin still the most broadly utilized test for iron deficiency but cannot be used for patients with chronic infection, inflammation ,chronic kidney disease or neoplasia, in addition to investigated for iron, and transferrin saturation ,soluble transferrin receptor, or a transferrin receptor-ferritin index may enhanced the accuracy[28]. Feedback on Moeinvaziri et al[29]results whom proposed that patients have a SFL of less than or equal to 30 ng/ml complaining of active hair fall must be taken iron therapy .Reduced SFLs better to be correct by giving iron supplementation orally that is relatively inexpensive, safe, and popularly well tolerated. To reaching the standardized values of iron in body may need four to six months or more and treatment may be stopped once these values be at 70 ng/ml [30,31,32]. The mean level of hemoglobin for patients group was 11.36 g/dl which is comparable with

other studies[33,34]. while in the control group the mean hemoglobin value was 11.87 g/dl that featured by a statistically insignificant difference of 0.51 g/dl from TE patients (P value >0.05). This result may be because of hemoglobin, and red blood cell indexes are inadequate screens of iron deficiency[28]. The mean value of vitamin D among the cases came out to be significantly lower than the controls (*P* value =0.018). This was similar to a study on AA where the patients with AA had significantly lower values of vitamin D than controls (*P* value > 0.001) [35,36]. In our study, the mean value of vitamin D among the females was significantly lower for the cases as comparison to the controls (*P* value =0.018) which is in agreement with another study, in which the vitamin D levels in females with CTE came out to be significantly lower among cases as compared to the controls (*P* > 0.001) [37]. Our study showed that vitamin D levels among most of the cases fell in the vitamin D insufficiency category (76.66%), whereas most of the controls were in the vitamin D sufficiency category (41.66 %) and the difference in these categories came out to be significant which proves that vitamin D has a significant role in hair loss and vitamin D supplementation can be helpful in such cases. Interestingly, many researchers have emphasized to the close relation that present between the concentration of vitamin D and the iron level[38,39] . Also despite of the varies in pathogenesis in ferritin and vitamin D there was no significant difference detected in TE between their levels this finding advowson the formerly supposed 'threshold hypothesis'[12] which declared that reduced iron stores lower the threshold resulting in different forms of hair loss and not a specific type, additional investigations are needed to decided whether the same connotation applies to vitamin D or not. In spite of the role of vitamin D in hair follicle cycling and hair disorders has been proposed[40].In this study, its deficiency / insufficiency has been evinced in relation To CTE. A review done by Amor *et al*. cited a need for evidence-based data for recommendation of vitamin D supplementation[40]. In a study done by Bleiker *et al*., topical calcipotriol a synthetic derivative of calcitriol was found to have not any role in protecting against hair loss[41]. Our results agree with previous reports[12,29,37,42,43] confirm the relation between reduce iron stores measured by serum ferritin concentrations and TE in females. otherwise, another studies[4,44,45] found no considerable relevance between TE and iron deficiency. There is no obvious clarification of this disagreement and further work is absolutely desirable to resolve this technical debate. The presence of numerous variables e.g. the study designs adopted in diverse studies, the changeability of the classification of a standard SFL in females and the varies orientation ranges used by different laboratories are various factors that could donate in this detected disagreement[44]. furthermore, the difference in the SFLs detected in other studies could be peculiarity to the study group itself. This is owing to the differences in the nutritional routine of the incorporated subjects[46] in addition to the hereditary and racial variations[47] might all control the iron status and thereby the SFLs. Gastrointestinal, autoimmune, renal and hepatic disorders plus undernourishment are disorders that can be accountable for reduce VDL [48] and SFLs and for hair loss. In this study, we endeavor to keep out any patients with such disorders. Hair loss can have an exciting trauma on patients leading to nervousness and disappointment. as a result, diagnosing the fundamental etiology is obligatory for the better organization of the disorder.

Conclusions

The female cases in our study had significantly low levels of SF and vitamin D than controls .Our study highlights the importance of serum ferritin and vitamin D evaluation in case of diffuse hair fall. Since our study group was small and confined to a particular area there is a need for a larger study involving different areas .There is also a need to study the pattern of hair growth following iron supplementation and vitamin D supplementation in the affected group. Considering the rural and financial background of a majority of patients in Iraq testing for vitamin D may not be possible for all patients with complaints of diffuse hair fall due to the cost of the test. Our study tries to emphasize on the need to use vitamin D supplements as a part of hair fall treatment.

Ethical Clearance: The procedure and the purpose of study were explained to all patients and advice on specific care and treatment also given to them .

Source of Funding:- Self

Conflict of Interest:- Nil

References

1- Thomas P.HABIF. ″Clinical dermatology″. 6th ed. St Louis Mosby; 2016:844-845.

2- Fatani M.I., Bin mahfoz A.M., Mahdi A.H., Alafif K.A., Hussain W.A., Khan A.S., Banjar A.A.. Prevalence and factors associated with telogen effluvium in adult females at Makkah region, Saudi Arabia: A retrospective study. JDDS. 2015 Jan; 19(1): 27–30

3- Harrison S, Sinclair R. Telogen effluvium. Clin Exp Dermatol. 2002;27(5):389–3957

4- Sinclair R. There is no clear association between low serum ferritin and chronic diffuse telogen hair loss. Br J Dermatol. 2002;147(5):982–984

5- Wiedemeyeer K, Schill WB, Loser C. Diseases on hair follicles leading to hair loss part I:Nonscarring alopecias. Kinmed 2004;3:209-14.

6- Thiedke CC. Alopecia in women. Am Fam Physician 2003;67:1007-14

7- Whiting D.A. Chronic telogen effluvium: increased scalp hair shedding in middle-aged women. J Am Acad Dermatol. Dec 1996;35(6):899-906.

8- Sawaya ME. Purification of androgen receptors in human sebocytes and hair. J Invest Derm atol 1992;98: 925-965.

9- Shapiro J. Diseases of the hair. In: Raykel R, editor. Conn's current therapy. Philadelphia, Pa: WB Saunders; 1996. p. 739-41

10- McMichael A. Approach to office visits for hair loss in women. Cutis 2011;87:8-9.

11- Paus R, Olsen EA, Messenger AG. Hair growth disorders. In: Wolff K, Goldsmith LA, Katz SI, Gilchrest BA, Paller As, Leffell DJ, editors. Fitzpatrick's Dermatology in General Medicine. 7 th ed. USA; The McGraw-Hill Companies Inc.; 2008. p. 753-77.

12- Kantor J, Kessler LJ, Brooks DG, Cotsarelis G. Decreased serum ferritin is associated with alopecia in women. J Invest Dermatol. 2003;121(5):985–988

13- Trost L.B., Bergfeld W.F., Calogeras E. The diagnosis and treatment of iron deficiency and its potential relationship to hair loss. J Am Acad Dermatol 2006;54:824-44.

14- Adamson JW. Iron deficiency and other hypoproliferative anemias. In: Kasper DL, Braunwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL, editors. Harrison's principles of internal medicine. 16 th ed. New York: McGraw-Hill; 2005. p. 586-92

15- Umbreit J. Iron deficiency: A concise review. Am J Hematol 2005;78:225-31

16- Schrier SL. Treatment of anemia due to iron deficiency. Available from: http://www.UpToDate.com. [Last accessed on 2005 Apr 18, last updated on 2001 Feb 27].

17- Goddard AF, McIntyre AS, Scott BB. Guidelines for the management of iron deficiency anaemia. British Society of Gastroenterology. Gut 2000;46:1-5.

18- Bottomley SS. Secondary iron overload disorders. Semin Hematol 1998;35:77-86.

19- Paus R, Cotsarelis G. The biology of hair follicles. N Engl J Med. 1999;341:491–7

20- Buhl AE. Minoxidil's action in hair follicles. J Invest Dermatol 1989;92:315-20

21- Arck PC, Handjiski B, Peters EM, Hagen E, Klapp BF, Paus R. Topical minoxidil counteracts stress-induced hair growth inhibition in mice. Exp Dermatol 2003;12:580-90.

22- Arck PC, Handjiski B, Hagen E, Joachim R, Klapp BF, Paus R. Indications for a''brain-hair follicle axis (BHA)'':Inhibition of keratinocyte proliferation and up-regulation of keratinocyte apoptosis in telogen hair follicles by stress and substance P. FASEB J 2001;15:2536-8

23- Hadshiew IM, Foitzik K, Arck PC, Paus R. Burden of hair loss: Stress and the underestimated psychosocial impact of telogen effluvium and androgenetic alopecia. J Invest Dermatol 2004;123:455-7

24- Rushton DH, Ramsay ID. The importance of adequate serum ferritin levels during oral cyproterone acetate and ethinyl oestradiol treatment of diffuse androgen-dependent alopecia in women. Clin Endocrinol (Oxf) 1992; 36: 421-427

25- Andrews NC. Disorders of iron metabolism. N Eng J Med 1999; 341: 1986-19

26- Zijp I.M., Korver O., Tijburg L.B.M. Effect of Tea and Other Dietary Factors on Iron Absorption. Crit Rev Food Sci Nutr 2010;40:371-398

27- Creed-Kanashiro HM, Uribe TG, Bartolini RM, et al. Improving dietary intake to prevent anemia in adolescent girls . J Nutr 2000; 130 (suppl 2S): 459S-461S

28- Elston D.M. Commentary: Iron deficiency and hair

loss: problems with measurement of iron. J Am Acad Dermatol. 2010 Dec;63(6):1077-82.

29- Moeinvaziri M., Mansoori P., Holakooee K., Naraghi Z.S., Abbasi A. Iron Status in Diffuse Telogen Hair Loss among Women. Acta Dermato venerol Croat 2009;17:279-284

30- Provan D. Mechanisms and management of iron deficiency anemia. Br J Haematol 1999; 105(suppl I): 19-26.

31- Rushton DH, Norris MJ, Dover R, Busuttil N. Causes of hair loss and the developments in hair rejuvenation. Int J Cosm Sci 2002; 24: 17-

32- Rushton DH. Nutritional factors and hair loss. Clin Exp Dermatol

33- Jean L. Bolognia MD,Julie V. Schaffer MD,Lorenzo Cerroni MD. Dermatology. 4th Ed.: 2018

34- lowell A.Goldsmith ,MD,MPH, STEPHN I. KATZ ,MD, phD et al., Fitzpatrick's Dermatology in General Medicine. 8th ed. New York McGraw-Hill, Health Professions Division, 2012.

35- Mahamid M, Abu-Elhija O, Samamra M, Mahamid A, Nseir W. Association between Vitamin D levels and alopecia areata. Isr Med Assoc J. 2014;16:367–70 .

36- Aksu Cerman A, Sarikaya Solak S, Kivanc Altunay I. Vitamin D deficiency in alopecia areata. Br J Dermatol. 2014;170:1299–304.]

37- Rasheed H, Mahgoub D, Hegazy R, El-Komy M, Abdel Hay R, Hamid MA, et al. Serum ferritin and Vitamin D in female hair loss: Do they play a role? Skin Pharmacol Physiol. 2013;26:101–7

38- Heldenberg D, Tenenbaum G, Weisman Y:Effect of iron on serum 25-hydroxyvitamin D and 24,25-dihydroxyvitamin D concentrations.Am J Clin Nutr 1992; 56: 533–536. 115-

39- Kiss Z, Ambrus C, Almasi C, Berta K, Deak G, Horonyi P, Kiss I, Lakatos P, Marton A, Molnar MZ, Nemeth Z, Szabo A, Mucsi I: Serum 25(OH)-cholecalciferol concentration is associated with hemoglobin level and erythropoietin resistance in patients on maintenance hemodialysis. Nephron Clin Pract 2010; 117:c373–c378.

40- Amor KT, Rashid RM, Mirmirani P. Does D matter? The role of Vitamin D in hair disorders and hair follicle cycling. Dermatol Online J. 2010;16:3

41- Reichrath J. Vitamin D and the skin: An ancient friend, revisited. Exp Dermatol. 2007;16:618–25.

42- Zlotogorski A, Hochberg Z, Mirmirani P, Metzker A, Ben-Amitai D, Martinez-Mir A, et al. Clinical and pathologic correlations in genetically distinct forms of atrichia. Arch Dermatol. 2003;139:1591–6 .

43- Zheng Y, Prouty SM, Harmon A, Sundberg JP, Stenn KS, Parimoo S: Scd3 – a novel gene of the stearoyl-CoA desaturase family with restricted expression in skin. Genomics 2001; 71: 182–191.

44- Bolland MJ, Ames RW, Grey AB, Horne AM, Mason BH, Gamble GD, Reid IR: Does degree of baldness influence vitamin D status? Med JAust 2008; 189: 674–675.

45- Burne TH, McGrath JJ, Eyles DW, Mackay-Sim A. Behavior characterization of vitamin D receptor knockout mice. Behav Brain Res. 2005;157:299-308.

46- Judd SE, Tangpricha V. Vitamin D deficiency and risk for cardiovascular disease. Am J Med Sci. 2009;338:40-4.

47- Rosso R, Kim N, Kirsner RS. Vitamin D intake and melanoma risk. J Invest Dermatol. 2009;129:1598

48- Tuohimaa P. Vitamin D and aging. J Steroid Biochem Mol Biol. 2009;114:78-84.