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(Research Article)

The impact of prolactin and vitamin D levels as a prognostic markers of female hair loss

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Abstract

A limited number of case reports seem to point the interaction between thinning hair and a vitamin D deficiency. This research looked at the relationship between prolactin levels and vitamin D levels in women with hair loss. The anterior pituitary gland secretes a polypeptide hormone called prolactin, which has a variety of biological effects, including the capacity to encourage growth and have a proliferative influence on human keratinocytes. Calcium homeostasis is affected by this hormone as a result of deficiency in vitamin D. This study was conducted on 75 patients during the period from November 2019 to March 2021. Serum prolactin and vitamin D levels were measured by chemiluminescence through an immunoassay (automated) and fluorescence Immunoassay (FIA) for vitamin D measurement. Serum prolactin levels were significantly elevated in pregnant women with hair loss compared with healthy controls. Vitamin D and serum prolactin levels had a remarkable positive correlation (r = 0.661, P 0.005). Prolactin and vit. D may play a part in hair loss in women.

Keywords: Hair loss; Supplementation; 25(OH) vitamin D; Prolactin

1. Introduction

Hair loss is described as having a lot of terminal hair in women are organized in a typical pattern, which affects 5–10% of women of reproductive age (Carmina *et al.*, 2019). The hair bulb is made up of the hair matrix and the dermal papilla, which is a cluster of specialized fibroblasts, blood vessels, and nerve terminals. (made up of keratinocytes that divide very quickly). The scalp hair follicles undergo repeated development cycles and are anchored in the subcutis because of enzymes in the hair structure (McGrath *et al.*, 2004). This makes up the majority of a strand known as hair, which is composed of keratinized, dead cells. The hair shaft and the hair follicle are the two components of the structure of hair. The upper and lower halves of the hair follicle's structure can be separated. The lower portion contains the bulb and suprabulbar region, while the upper section contains the infundibulum and isthmus. Broad, non-scarring hair loss in the frontal, middle, and partial lobes of the head without discernible hair thinning is how FPHL is diagnosed clinically. The forehead hairline is typically preserved (Tang *et al.*, 2000).

In previous investigations, numerous hormones have had a significant impact on both the hair cycle and the structure of the hair follicle (Chen *et al.*, 2022). For instance, by attaching to estrogen receptors and modulating aromatase activity, estradiol can dramatically affect hair follicle growth and cycle. Aromatase is the enzyme responsible for turning androgen into estrogen (E2). At the hair follicle level, progesterone reduces testosterone's conversion into DHT. Extensive studies have also looked into the role of prolactin (PRL) in hair development, and both PRL and PRL receptors have been found in human scalp skin (Grymowicz *et al.,* 2020). Despite the fact that many of these women have an abundance of hair without hyperandrogenemia, roughly 70–80% of females with elevated testosterone levels have

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hirsutism. Plasma androgens and the hair follicle's apparent susceptibility to androgens generate hirsutism through a response involving 5-alpha reductase activity and subsequent binding to the androgen receptor (Saini *et al*., 2021). The new mechanism by which prolactin can function as a calcium-regulating hormone is by upregulating TRPV6 mRNA in the intestine and working in concert with 1,25(OH)2D3 to control intestinal calcium transport proteins that affect vitamin D. Particularly, the effects of androgens have been thoroughly studied. The essential When androgen works on the hair follicle, it is referred to as attaching to androgen receptors in dermal papilla cells (Rosenfield, 1986). Vitamin D is involved in complex signaling processes that influence hair follicle growth and differentiation. The majority of research reveals a negative correlation between serum vitamin D levels and non-scarring alopecias like trichotillomania, telogen effluvium, androgenetic alopecia, and alopecia areata. Scarring alopecia is also linked to vitamin D insufficiency (Oda *et al*., 2020). Vitamin D supports differentiation but has little effect on hair follicle development. Vitamin D levels are comparable in people with alopecia and genetically insufficient Vitamin D receptors (VDR). According to previous studies, VDR is necessary for a critical stage in the growth of hair follicles. The function of VDR is crucial for keratinocyte stem cells to stay in the bulge area of hair follicles, and reduced Vitamin D action will have the opposite effect (Grymowicz et al., 2020). Nevertheless, there isn't any research that can be considered conclusive to show how vitamin D supplementation can treat hair loss or treat these problems (Aksu Cerman *et al*., 2014). Therefore, further research is required before vitamin D is frequently suggested as a therapy option for these disorders. Hirsutism is seen in females when there is an excessive amount of terminal hair development in places that are particular to sex, usually as a result of an excess of androgen (Danial, 2016). As a result, the study's goal is to evaluate the blood levels of vitamin D and prolactin in Iraqi women who are suffering hair loss, compare those levels to those of healthy, normal subjects, and use those values as prognostic indicators.

2. Material and methods

2.1. Sample

In Al Muthanna Province / Central Health Laboratory , patients who were thought to be experiencing hair fall provided all samples for this research between November 2021 to December 2022. Blood samples were taken to further analyzing.

2.2. Physical Evaluation

2.2.1. Prolactin

Prolactin was assessed in this research using the CLIA-iflash 1800 (Shenzhen Yhlo Biotech Co., Ltd., China). Chemiluminescence Immunoassay for Ferritin (CLIA) Prolactin in human blood or plasma can be detected quantitatively using an immunoassay based on chemiluminescence and the CLIA-iFlash 1800. The manufacturing firm provided all of the test's reagents. This test's protocol was carried out in accordance with the manufacturer's directions.

2.2.2. Determination of Vitamin D3

This assessment was done according to the ichroma vitamin D kit (Boditech Med Inc.,Korea) that was used with the ichroma II instrument (Boditech Med Inc., Korea). The fluorescence immunoassay (FIA) used in this test determines the total concentration of 25(OH)D2/D3 in serum or plasma of human. The Ichroma vit. D test uses a competitive immune detection method. The target molecule in the sample binds to the fluorescence (FL)-labeled detection antibody in the detection buffer to form the complex that acts as the sample mixture in this test. The complex is loaded to migrate onto the nitrocellulose matrix, where the covalent couple of 25(OH)D3 and bovine serum albumin (BSA) is immobilized on a test strip, making it impossible for the target material and the FL-labeled antibody to bind to the complex. If more target material exists in the blood, less detection antibody is accumulated, resulting in a lower fluorescence signal. All steps of this method were done according to the manufacturer's company instructions.

2.3. Statistical analysis

SPSS was used to statistically analyze the findings. (version 22). Results were expressed as implied S.D. Independent t-tests, ANOVA, and LSDs were used to assess the significance of variations. To compare the investigated parameters of this study, Pearson correlation was used. Statistical significance was defined as a P value of 0.05 or less.

3. Results

To estimate the potential role of prolactin level and vit. D level on the physiological effects of hair loss in women. This research, comprised of 75 patients divided into three groups, comprises the findings of numerous analyses and offers a thorough, current grasp of the topic of the effects of prolactin fluctuations and vitamin D on the hair follicle during pregnancy. 25 pregnant participants in group I had hair loss, while 25 non-pregnant participants in group II had no hair loss and served as controls for group I and group III as healthy non-pregnant controls, as shown in table 1.. This table represents the age groups of study patients, and it shows a significant difference in the pregnant women's group. The majority of the age group of them (≥ 36) recorded a high level of prolactin and vitamin D, inversely to the age group (18) that recorded a low level. Also, there is a statistically significant difference in prolactin level regarding the course of cases, whereas a significant positive correlation existed in pregnant women at each age.

Table 1 Age distribution within study groups

Parameters	Age	Pregnant N=25	non-pregnant N=25	Control N=25
Vitamin D	≤18	9.8±2.3	9.6±1.2	15.8±5
	19-35	12.6±5	9.49±1.1	12.6±2.4
	≥36	29.2±21	9.4±0.7	13.7±1.68
	P value	0.007*	0.907	0.136
Prolactin	≤18	41.6±45	28.5±11.3	23.4±13.4
	19-35	36.5±19	39.4±34.7	23.5±10.9
	≥36	56.5±44	18.2±9	17.2±4
	P value	0.541	0.190	0.517

* indicates a substantial change at p<0.05.

The control group exhibited the greatest mean serum vitamin D level, reaching 15.8 ng/mL, while the non-pregnant group had the lowest level, 9.49 ng/mL. The highest average prolactin level in the pregnant group was 56.5 44 IU/L as opposed to the control group's 23.5 10.9 IU/L; this difference was a statistically significant. When comparing to the control group, there was a significant increase in vitamin D levels among study groups individuals as shown in table (2)

Table 2 Statistical comparison between the studied groups regarding serum prolactin level and Vitamin D levels among the studied groups

Parameters	(pregnant) n(25)(I)	(non-pregnant) (25)(II)	Control n(25)(III)	P
Vitamin D	13.6±7.89	9.48±0.99	13.74±3.4	a- 0.004*
				b- 0.997
				c- 0.007*
				d- 0.004*
Prolactin	38.78±23.9	30±26.3	22.2±10.7	a- 0.029*
				b- 0.015*
				c- 0.339
				d- 0.154

* at p <0.05 indicates a significant difference. The letters (a, b, c, and d) stand for the statistical analysis among the categories being studied in the following method: The Hair Loss (pregnant) group and the Control group, the Hair Loss (non-pregnant) group and the Hair Loss (pregnant), and the Hair Loss (non-pregnant) group pregnant) group were all the groups that were investigated.

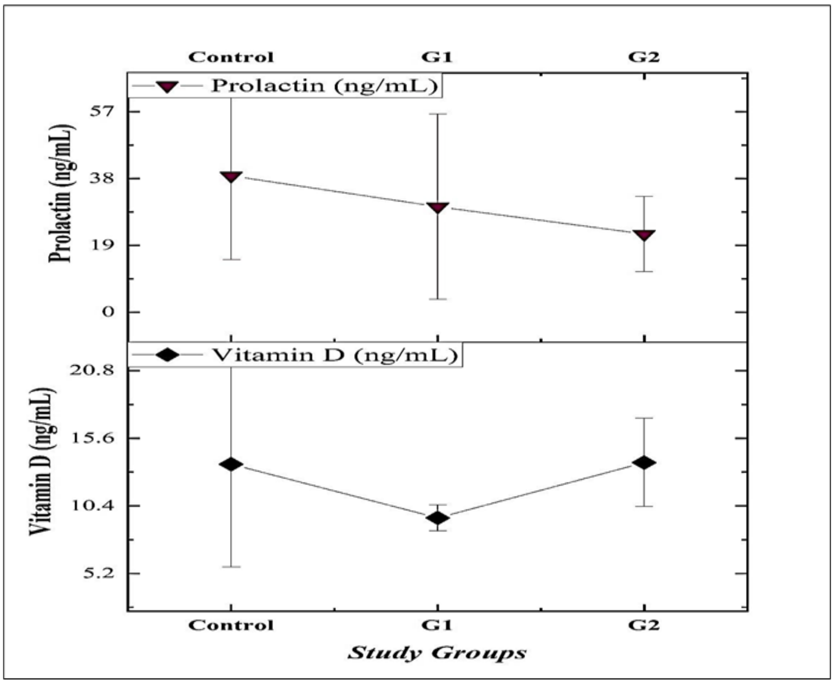

Figure 1 Depicted Vitamin D and Prolactin levels among the study subjects (Control, expecting (G1) women, and non-pregnant women with thinning hair) (G2).

Regarding vitamin D and prolactin levels in study groups versus control groups, prolactin levels were 38.78 ng/ml, 30 ng/ml, and 22.2 ng/ml, respectively, for each group, while vitamin D levels were recorded at 13.6 ng/ml, 9.48 ng/ml, and 13.7 ng/ml, respectively, for each group, as shown in Fig. 1. In addition, there is a significant difference in prolactin levels among study groups, whereas figure 2 shows a linear relationship between two study variables in pregnant women and non-pregnant women without hair loss. This indicates there is no correlation between serum prolactin and vit. D levels in these groups. While there is a high positive correlation between prolactin hormone and vitamin D levels in non-pregnant group and the pregnant group with hair loss, as shown in figure 4,

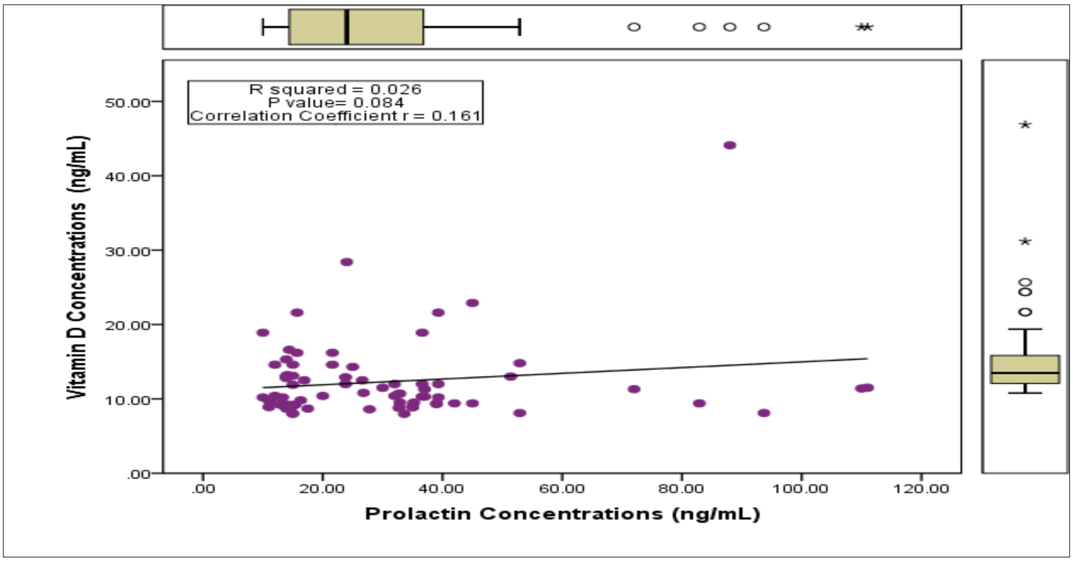

Figure 2 Correlation coefficient between serum prolactin and vitamin D, patients (*n*=25) using a box plot and scatter diagram, amounts were determined in each of the three study groups (Control, hair loss Pregnant, and hair loss non-Pregnant women)

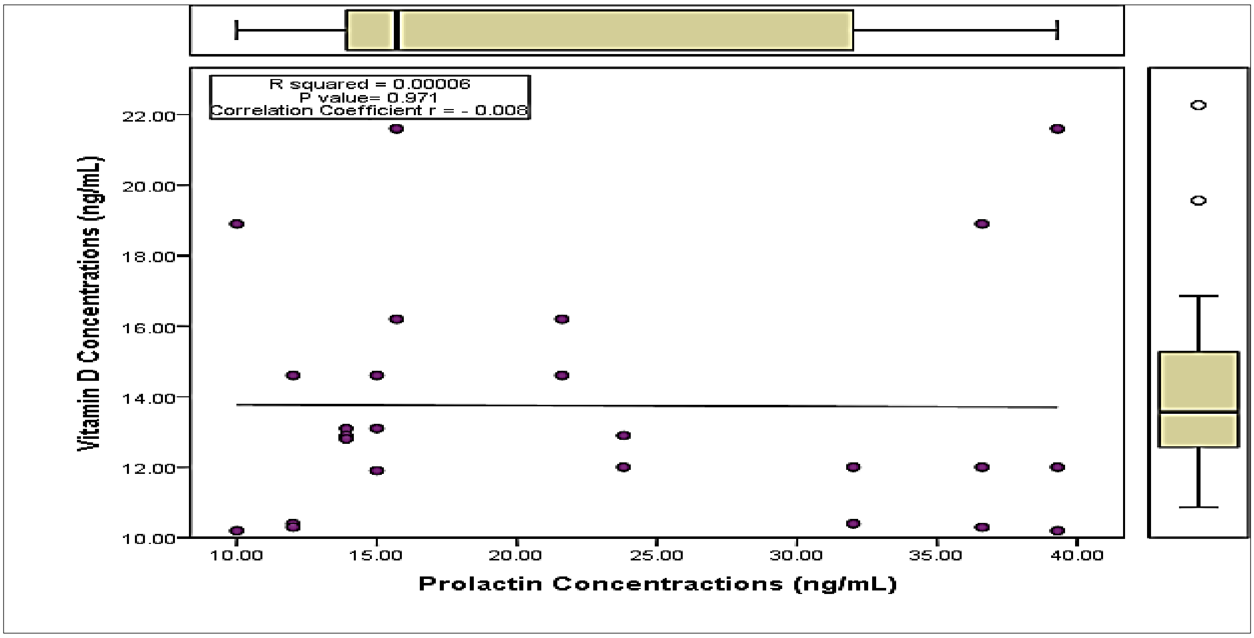

Figure 3 Patients (n=25) in the control group (not expectant and not experiencing hair loss) were correlated with serum prolactin and vitamin D using a box plot and scatter diagram

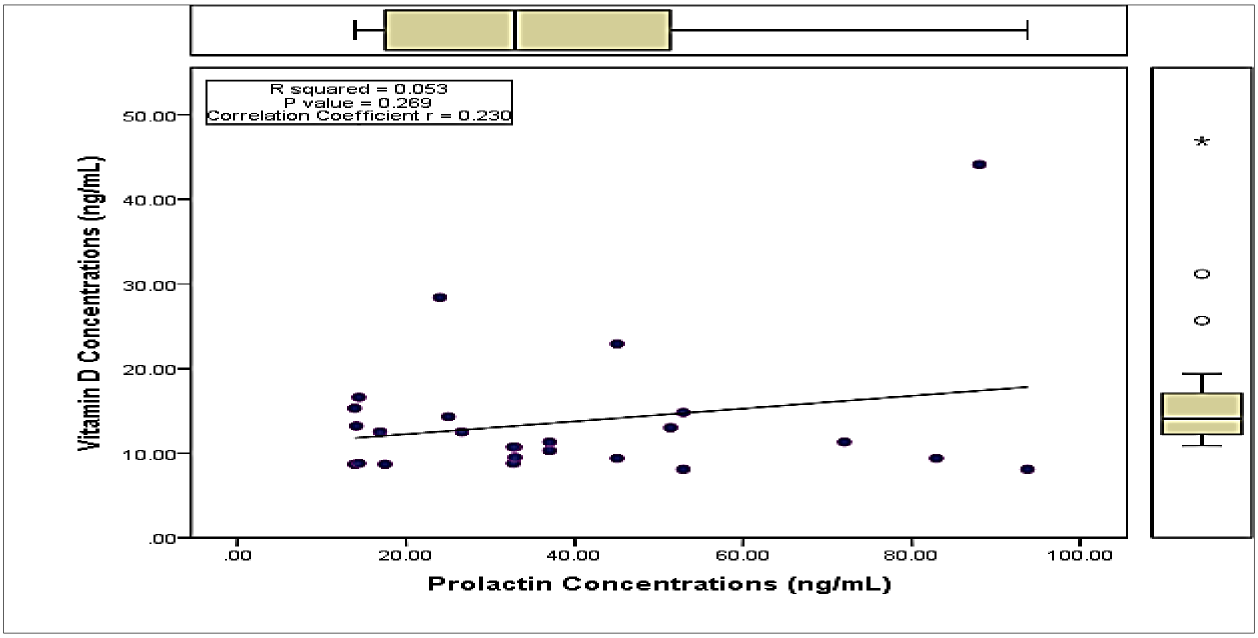

Figure 4 Box plot and scatter diagram analysis of the correlation coefficient between blood prolactin and vitamin D levels in pregnant women who are experiencing hair loss (n=25)

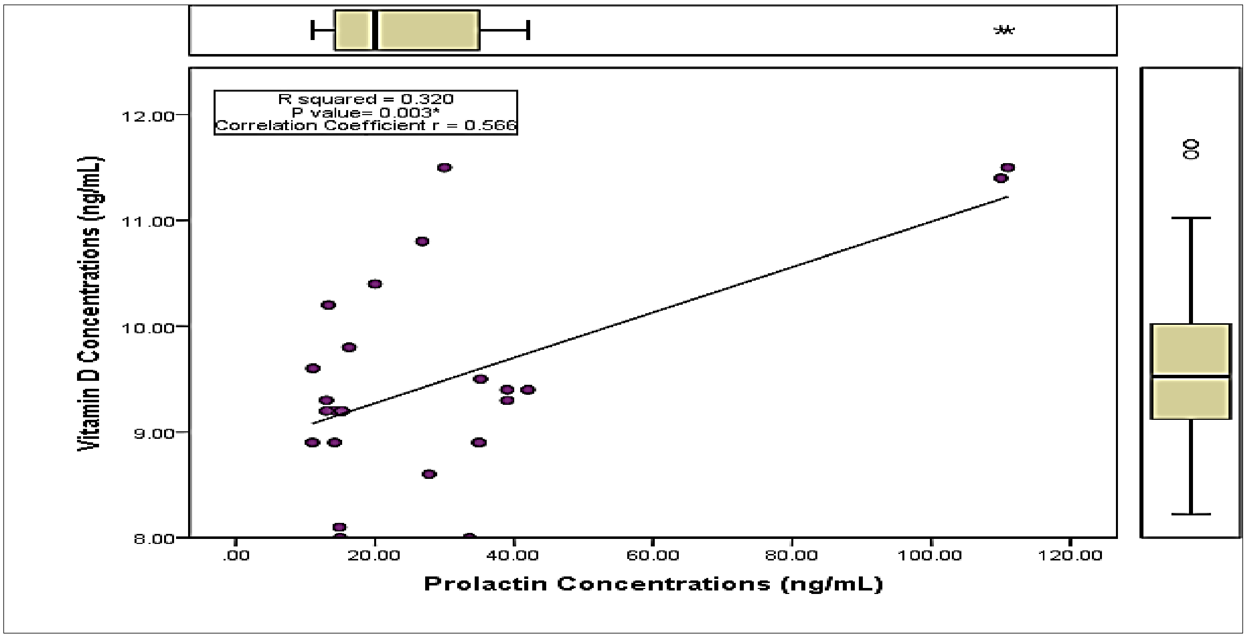

Figure 5 Using a box plot and scatter diagram, examine the correlation coefficient between blood prolactin and vitamin D concentrations in the group of non-pregnant women who are experiencing hair loss (n=25)

4. Discussion

In this study, focusing on the measurement of prolactin levels can regulate calcium because it increases vitamin D levels. The current study's results are consistent with the idea that reduced serum prolactin and levels of vitamin D are involved in the reduced hair density observed in FPHL patients. Comparing individuals with FPHL to controls, the mean of vit. D level was significantly low (P< 0.001). Additionally, serum prolactin levels were significantly high than controls (P <0.05) in comparison. This is because there is a substantial positive correlation between serum prolactin levels and hair loss, whereas there was none in the control cases. The current study aligns with (Moneib *et al.*, 2018 and Zheng *et al.*, 2001). Consequently, ladies who are experiencing hair loss should have their vitamin D levels checked again, and vitamin D dietary supplements may be helpful in treating these patients. Along with (Bleizgys, 2021) investigations, most of the hair loss in pregnant and non-pregnant women was discovered in our study. It has been suggested that a healthy amount of vitamin D is required to prevent both hair loss and signs of aging; this may help to understand how crucial vitamin D is for healthy hair. Furthermore, numerous findings from animal models clearly show that vitamin D receptor activation is a key factor in the hair follicle cycle, particularly in the initiation of anagen (Rasheed *et al.*, 2013). Records also suggest that the vitamin D receptor controls the production of genes necessary for cycling of hair follicle, either directly or indirectly (Belgaumkar *et al.*, 2021). According to some studies, women with alopecia areata, female pattern hair loss, and chronic telogen effluvium have low amounts of vitamin D in their serum (Banihashemi *et al.*, 2016). While other studies showed no correlation between the extent and severity of male androgenetic alopecia and serum vitamin D levels (Saini *et al.*, 2021). Even if there were few patients with the severe form of FPHL, recent research shows that levels of vitamin D in pregnant and non-pregnant women were significantly lower, indicating that the severity of hair loss was closely related to the level of vitamin D deficiency. A vitamin D threshold level of less than 25 ng/mL was determined for FPHL based on the current analysis. Additionally, it supported the findings of (Belgaumkar et al., 2021) study. Patients who had FPHL were found to have elevated prolactin levels in 81% of cases, and 10% of them additionally had low serum vitamin D levels, which is a severe indicator of vitamin D deficiency (Arnaboldi *et al.*, 2015). (either insufficient or deficient). This data demonstrated that instances of hair loss were associated with high prolactin levels, and low vitamin D levels may contribute to the early onset of FHP, as shown in Fig. 4. As a result, people with FHP should have their vitamin D levels checked (Grymowicz et al., 2020). Key contributors in the development of terminal hair (A) are androgens such as testosterone (T), dihydrotestosterone (DHT), and its prohormones, dehydroepiandrosterone sulfate (DHEAS), and androstendione. They trigger the transformation of sex-specific vellus hairs into terminal hairs, which are bigger and darker. Dermal papilla cells in hair follicles include androgen receptors, which they bind to. The skin of the human scalp contains PRL receptors and prolactin (PRL), which has been widely researched for its impact on hair formation. This is consistent with earlier findings by (Christakos *et al.*, 2016). In addition to its direct impacts on the intestine, prolactin was found to have an impact on the transcription and expression of the enzyme 1 (OH)ase in kidney cells. Early research revealed that breastfeeding and pregnancy both result in higher blood levels of 1,25(OH)2D3 (Alkhalifah *et al*., 2010). There is a sizable calcium flux to the fetus and the neonate, respectively, during pregnancy and breastfeeding. A decrease in blood calcium is caused by the drain on the plasma calcium pool (Ross and Shapiro, 2005). It has therefore been proposed that the decrease in serum calcium during late pregnancy and breastfeeding may activate the renal 1 (OH) assay via PTH. Rats that were lactating experienced a 70% inhibition of the 1,25(OH)2D3 rise after parathyroid dectomy (El Tahlawi et al., 2018). The current study found the highest level of connection between age and hormone and vitamin levels. (Table.1). According to this study, women with high prolactin levels aged 18 to 36 had the most incidences of hair loss, followed by those aged 19 to 35. As seen in the table, the figure depicts how vitamins and hormones work together as a trigger. Prolactin may be involved in the etiology of vitiligo and psoriasis, according to previous investigations. In-depth research has been done in animals on how PRL affects hair growth (Darwin et al., 2018). In this study, prolactin directly controls hair development. It is linked to vitamin D and deals with other studies that mentioned its inhibitory effect on hair shaft elongation and the early induction of the catagen phase, as demonstrated in Fig. 4. PRL also seems to reduce 5-alpha reductase activity (Grymowicz *et al*., 2020). Additionally, the thickness of hair growth increases during pregnancy. It's possible that the numerous alterations experienced during pregnancy, including elevated levels of human chorionic gonadotropin, progesterone, and prolactin, as well as a variety of growth factors and cytokines, are to blame for the acceleration of hair growth in pregnant women as well as an increase in hair diameter and the anagen/telogen ratio (Darwin et al., 2018). In an attempt to slow or stop the progression of alopecia, this research should encourage us to evaluate vitamin D levels at an early stage of hair loss. It is important to note that the majority of Iraqi women are in danger of acquiring vitamin D deficiency because they do not receive enough sunshine exposure, dress modestly by covering the majority of their bodies, or consume foods high in vitamin D.

5. Conclusion

In this study, focusing on the measurement of prolactin levels can regulate calcium because it increases vitamin D levels. The current study's results are consistent with the idea that reduced serum prolactin and levels of vitamin D are involved in the reduced hair density observed in FPHL patients. Comparing individuals with FPHL to controls, the mean vitamin D level was significantly lower ($P< 0.001$). Additionally, serum prolactin levels were significantly higher than controls ($P <0.05$) in comparison. According to the results of this study, pregnant patients' serum PRL levels were substantially higher than those of healthy controls. In patients who were experiencing hair loss, the levels were associated with clinical severity. Therefore, the blood PRL level may be used as a diagnostic biomarker to evaluate the clinical state of people who are balding. To confirm the association between serum PRL and vitamin D levels, more experimental research in a larger population and an investigation of the full effect of hormone control on hair growth are required. Additional studies examining how women with FPHL respond to vitamin D supplementation are highly advised in order to confirm or disprove any correlation between low vitamin D levels and FPHL.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Aksu Cerman, A., Sarikaya Solak, S. and Kivanc Altunay, I., 2014. Vitamin D deficiency in alopecia areata. British Journal of Dermatology, 170(6), pp.1299-1304.

[2] Alkhalifah A, Alsantali A, Wang E, McElwee KJ, Shapiro J.2010. Alopecia areata update: part 1. Clinical picture, histopathology, and pathogenesis. J AmAcad Dermatol; 62:177–188

[3] Arnaboldi F, Busnelli M, Cornaghi L, Manzini S, Parolini C, Dellera F, Ganzetti GS, Sirtori CR, Donetti E, Chiesa G. 2015. High-density lipoprotein deficiency in genetically modified mice deeply affects skin morphology: A structural and ultrastructural study. Experimental Cell Research. Oct 15;338(1):105-12.

[4] Banihashemi, M., Nahidi, Y., Meibodi, N.T., Jarahi, L. and Dolatkhah, M., 2016. Serum vitamin D3 level in patients with female pattern hair loss. International journal of trichology, 8(3), p.116.

[5] Belgaumkar, V.A., Chavan, R.B., Deshmukh, N.S., Patil, P., Bhatt, N. and Agrawal, K., 2021. Evaluation of serum ferritin, vitamin B12 and vitamin D levels as biochemical markers of chronic telogen effluvium in women. Int J Res Dermatol, 7, pp.407-12.

[6] Bleizgys, A., 2021. Vitamin D and COVID-19: It is time to act. International Journal of Clinical Practice, 75(3), p.e13748.

[7] Carmina, E., Azziz, R., Bergfeld, W., Escobar-Morreale, H.F., Futterweit, W., Huddleston, H., Lobo, R. and Olsen, E., 2019. Female pattern hair loss and androgen excess: a report from the multidisciplinary androgen excess and PCOS committee. The Journal of Clinical Endocrinology & Metabolism, 104(7), pp.2875-2891.

[8] Chen, J., Li, K., Hu, A., Fu, Q., He, H., Wang, D., Shi, J. and Zhang, W., 2022. The molecular characteristics of DOMs derived from bio-stabilized wastewater activated sludge and its effect on alleviating Cd-stress in rice seedlings (Oryza sativa L.). Science of The Total Environment, 845, p.157157.

[9] Christakos, S., Dhawan, P., Verstuyf, A., Verlinden, L. and Carmeliet, G., 2016. Vitamin D: metabolism, molecular mechanism of action, and pleiotropic effects. Physiological reviews, 96(1), pp.365-408.

[10] Danial ,W.W. 2016.Biostatistics:Afoundation for analysis in the health science 3rd.John wiley,Elsherief, Walid M., and Abdalla M. Aljarrari. "Serum Testosterone Levels and Statin Therapy in type two Diabetic and Hypertensive Libyan Male Subjects." PhD diss., University of Benghazi,.

[11] Darwin, E., Hirt, P.A., Fertig, R., Doliner, B., Delcanto, G. and Jimenez, J.J., 2018. Alopecia areata: review of epidemiology, clinical features, pathogenesis, and new treatment options. International journal of trichology, 10(2), p.51.

[12] El Tahlawi SM, El Eishi NH, Kahhal RK, Hegazy RA, ElHanafy GM, AbdelHay RM, et al.2018. Do prolactin and its receptor play arole in alopeciaareata?. Indian J Dermatol; 63:241–245.

[13] Grymowicz M, Rudnicka E, Podfigurna A, Napierala P, Smolarczyk R, Smolarczyk K, Meczekalski B. 2020. Hormonal Effects on Hair Follicles. Int J Mol Sci. Jul 28;21(15):5342.

[14] Grymowicz, M., Rudnicka, E., Podfigurna, A., Napierala, P., Smolarczyk, R., Smolarczyk, K. and Meczekalski, B., 2020. Hormonal effects on hair follicles. International journal of molecular sciences, 21(15), p.5342.

[15] Grymowicz, M., Rudnicka, E., Podfigurna, A., Napierala, P., Smolarczyk, R., Smolarczyk, K. and Meczekalski, B., 2020. Hormonal effects on hair follicles. International journal of molecular sciences, 21(15), p.5342.

[16] Grymowicz, Monika, Ewa Rudnicka, Agnieszka Podfigurna, Paulina Napierala, Roman Smolarczyk, Katarzyna Smolarczyk, and Blazej Meczekalski. 2020. "Hormonal Effects on Hair Follicles" International Journal of Molecular Sciences 21, no. 15: 5342. https://doi.org/10.3390/ijms21155342

[17] McGrath, J.A., Eady, R.A.J. and Pope, F.M., 2004. Anatomy and organization of human skin. Rook's textbook of dermatology, 1, pp.3-2.

[18] Moneib, H.A., Youssef, S.S., Aly, D.G., Rizk, M.A. and Abdelhakeem, Y.I., 2018. Autologous platelet-rich plasma versus conventional therapy for the treatment of chronic venous leg ulcers: a comparative study. Journal of cosmetic dermatology, 17(3), pp.495-501.

[19] Oda, Y. and Bikle, D.D., 2020. Vitamin D and calcium signaling in epidermal stem cells and their regeneration. World journal of stem cells, 12(7), p.604.

[20] Rasheed, H., Mahgoub, D., Hegazy, R., El-Komy, M., Hay, R.A., Hamid, M.A. and Hamdy, E., 2013. Serum ferritin and vitamin d in female hair loss: do they play a role?. Skin pharmacology and physiology, 26(2), pp.101-107.

[21] Rosenfield, R.L., 1986. 9 Pilosebaceous physiology in relation to hirsutism and acne. Clinics in endocrinology and metabolism, 15(2), pp.341-362.

[22] Ross EK, Shapiro J. Management of hair loss. Dermatol Clin .2005; 23:227–243.

[23] Saini, K. and Mysore, V., 2021. Role of vitamin D in hair loss: a short review. Journal of cosmetic dermatology, 20(11), pp.3407-3414.

[24] Tang PH, Chia HP, Cheong LL, Koh D. (2000): A community study of male androgenetic alopecia in Bishan, Singapore. Singapore medical journal; 41:202-205

[25] Zheng Y, Prouty SM, Harmon A, et al. (2001): Scd3 – a novel gene of the stearoyl-CoA desaturase family with restricted expression in skin. Genomics;71: 182–191