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Effect of zinc, ferritin, and vitamin B12 deficiency on hair loss in pregnant women

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***Abstract*---**Diffuse hair loss affects around 50% of women during their lives. Vitamins play an important role in cell growth and their deficiency may cause diffuse hair loss. However, vitamin deficiency during pregnancy is common and can influence hair growth and quality. Herein, we investigate whether a possible relationship exists between Ferritin, Hemoglobin (Hb), TSH, Zinc, vitamin B12, and vitamin D levels and hair loss in women of various age groups and different pregnancy periods. Our retrospective study included 85 women among which 35 were healthy and between 17-48 years, and 50 were pregnant with chronic diffuse hair loss and between17-48 years. Pregnant women were equally divided according to their month of gestation: Months 1-3 and Months 4-9. The aforementioned vitamins' records were obtained from all participants. Pregnant women with severe hair loss during their last two trimesters had significantly lower zinc, hemoglobin, PCV, ferritin, and vitamin B12 levels, while there was no significant difference in their vitamin D and TSH levels when compared to non-pregnant women. Pregnant women with diffuse hair loss in their first trimester showed only a significant decrease in TSH level in pregnant women in their first trimester when compared to the other two groups. Collectively, our data show that pregnant women during their last two trimesters display significantly lower levels of Zinc, Hemoglobin, PCV, Ferritin, and vitamin B12 in comparison with pregnant women in their first trimester and non-pregnant women and this was associated with increase in hair loss. However, no significant change in their vitamin D and TSH levels was observed as compared to non-pregnant women.

***Keywords*---**hair loss, pregnancy, zinc, ferritin, B12.

Introduction

Diffuse hair loss is a form of hair loss in which hair falls out uniformly from all parts of the scalp. There are several forms of diffuse hair loss, the most prevalent being telogen effluvium, which results from physiological stress. [1] Diffuse hair loss also includes female pattern hair loss and the diffuse form of alopecia areata. Alopecia (hair loss) significantly affects both sexes and may be caused by genetic or acquired disorders. Diffuse hair loss is not a permanent condition. [2] It is estimated that about 49% of women will experience hair loss at some point in their life [3].

Vitamins are essential for typical cell growth and function and can promote hair loss if lacking [4]. In women, hair loss may be the result of nutrient deficiency, especially iron deficiency [5]. Iron contributes to hemoglobin (Hb) production, which helps to provide nutrients and oxygen to hair follicles. Without sufficient iron, hair will not grow normally, increasing hair thinning progressively [6]. To detect iron deficiency, Ferritin and hemoglobin (Hb) levels can be tested. Hair loss is thought to be caused in part by low iron reserves [6]. Hair follicle formation is thought to be influenced primarily by micronutrients, minerals (Zinc, Ferritin), vitamins (vitamin D and B12), and hormones (thyroid hormone) [7]. It was found that blood Ferritin and vitamin D concentrations should be determined before treating patients with diffuse hair loss and administered as supplements, i.e. after comparing the effectiveness of these components in healthy people and patients suffering from diffuse hair loss [8].

The relationship between dietary elements and hair loss is still a subject of debate. Similar to iron deficiency, zinc deficiency has been shown to reduce hair growth and damage any remaining hair, causing it to tear [9]. The use of zinc and iron supplements as supportive therapy is based more on anecdotal evidence than on clear-cut evidence. It makes sense to only prescribe nutritional supplements in cases when a deficiency is known to exist because an excessive intake of supplements may promote hair loss [10]. In terms of hair loss, zinc inhibits hair follicle regression and speeds up hair follicle healing. It also plays an important role in maintaining the sebaceous glands associated with hair follicles. [11]

Clinical experience has shown that pregnant women's TSH levels quickly increase along with a drop in hemoglobin (HB) and serum Ferritin levels. According to a few clinical investigations, iron shortage during pregnancy impacts thyroid function, where hypothyroidism and hyperthyroidism can cause loss of hair. In China, with adequate iodine intake, Yu et al. found that iron insufficiency is a separate risk factor for isolated hypothyroxinemia during the first trimester of pregnancy [12]. Additionally, studies suggest that vitamin B12 deficiency is associated with hair loss. Vitamin B12 also aids in the production of red blood cells which are oxygen carriers all over the body, including the scalp [4]. If the scalp is deprived of much oxygen, this will not only lead to hair loss but also hair follicles will not maintain hair regrowth [4]. Research has revealed that vitamin B12 insufficiency is frequently observed in pregnancy, and it is emerging as a growing public health issue [13]. Vitamin B12 deficiency is very common in people

with hypothyroidism [14], which is an indirect way for vitamin B12 deficiency to cause hair loss.

Young age groups showed a link between the prevalence of hair loss and lower serum levels of vitamin D3 [15]. Vitamin D is a class of fat-soluble secosteroids that aid in the absorption of calcium, iron, magnesium, phosphate, and zinc in the intestine [16]. Hair loss may also be caused by Vitamin D3 deficiency [17]. Vitamin D is metabolized by keratinocytes, skin cells that produce keratin, a protein in hair [17]. When the body doesn't manufacture adequate vitamin D, keratinocytes in hair follicles have difficulty in controlling hair growth and sloughing [17].

The patient's medical history should be carefully examined to find any known triggers behind hair loss. Causes can range from less common zinc deficiency to more frequent nutritional or hormonal issues like thyroid metabolism abnormalities, which are both easily treatable [18]. In the present study, we aimed at investigating whether a relationship exists between serum Zinc, vitamin B12, Ferritin, and vitamin D3 levels as well as parameters of iron metabolism and thyroid function with diffuse hair loss and their outcomes during pregnancy.

Materials and Methods

Study participants

In our retrospective study, 85 participants were enrolled at "AL-Hussein technical hospital." 50 pregnant women with an average age ranging between 17 – 45 years old who were all diagnosed with chronic diffuse hair loss were included. According to their gestational period, they were classified into two groups: Group A included 25 women in the first trimester (1–3 months), and Group B included 25 women either in the second or third trimester (4–9 months). The comparable control female group (Group C) (N= 35) of similar age (17–45 years) was also included in this study. The demographic characteristics, including age, were taken into consideration. The study was taken over for three months (from February to March 2022). During enrollment, participants with metabolic and endocrine disorders, hormone-replacement therapy, chemotherapy, immunosuppressive therapy, and vitamin and mineral supplements were excluded. The data retrieval was approved by the headboards of each laboratory and was conducted with informed consent.

Vitamins levels determination

All the data was obtained from different medical laboratories located in the Al-Muthanna Provence of Iraq. After at least 10 hours of fasting, venous blood was obtained from all participants. Part of each sample was used to determine the serum levels of certain vitamins. For this, serum separator tubes were allowed to stand for 30 min, and then they were centrifuged at 5000 rpm for 10 min. The other part of the sample was recovered on an anticoagulant EDTA tube for a complete blood count. The normal ranges of the studied parameters are as follows: Ferritin for female (10 – 120ng/ml), Zinc (70 – 150µg/dl), TSH (0.2 – 5.0 mIU/l), Hb for female (12 – 14 g/l), PCV for female (37-43%), vitamin B12 (150–

950 ng/ml), vitamin D (20-70 ng/ml). Serum Iron, Hb, Ferritin, and vitamin B12 concentrations in pregnant women and control groups were compared against the reference intervals. Zinc levels were photometrical measured using chemistry analyzer Smart- 150 (GenoTEK, Canada). According to the manufacturer's instructions, intraassay CV was 1.02%, interassay CV was 2.09%, and linearity range was 10–1000 µg/dL for iron. Ferritin, and vitamin B12 and vitamin D3 levels were measured with sandwich immuno-enzymatic method using AFIAS-6 (Boditech, Korea) analyzer. Intra-assay CV, inter-assay CV, and linearity range were given by the manufacturer as 3.6%, 4.3%, and 0.2–1500ng/mL for Ferritin, respectively; and 4.8%, 6.6%, and 50–1500 pg/mL for vitamin B12, respectively. Complete blood count was performed on an Autohomolyzer (HORIBA, China) using histochemical and flow cytometric methods.

Statistical analysis

Data were collected using Microsoft Excel and were statistically analyzed using Statistical Package for Social Sciences Software version 26.0 (SPSS, Inc., IBM Corporation). The normality of data was checked using the Shapiro-Wilk test. One-Way Analysis Of Variance (ANOVA) test, followed by Tukey's post-hoc test, was performed to test the difference between the different groups. A p-value less than 0.05 was considered statistically significant.

Results

The study population consisted of 85 women among which 50 were diagnosed with diffuse hair loss and were pregnant and 35 were non-pregnant with no diffuse hair loss. The mean age of groups A, B, and C was 30.6±6.6 years, 28.8±6.9 years, and 33.1±9.9 years, respectively. Vitamin D, Zinc, Hemoglobin, PCV, Ferritin, vitamin B12, and TSH levels have been compared among the three groups. Our results revealed sufficient levels of Zinc and Ferritin minerals in the above three groups, with higher levels being present in the non-pregnant women and women in the first trimester. This decrease in the pregnant women in the second and third trimesters for the above minerals was found to be statistically significant when compared to pregnant women in their first trimester and non-pregnant women (Figures 1 and 2).

Concerning vitamins D and B12, their levels were within the normal range for non-pregnant and pregnant women in the first trimester in contrast to pregnant women in the second and third trimesters. Our statistical analysis revealed no statistically significant difference between the three groups for vitamin D (Figure 3). On the other hand, a statistically significant difference was observed between the pregnant women in the second and third trimesters compared to pregnant women in the first trimester and non-pregnant women (Figure 4). Moreover, hemoglobin and PCV levels were also investigated in the above groups. Our results revealed insufficient levels in pregnant women in the second/third trimesters vs. pregnant women in the first trimester and non-pregnant women. ANOVA, followed by Tukey's post-hoc test, revealed that the observed decrease in hemoglobin and PCV levels was statistically significant (Figures 5 and 6).

Finally, TSH level was measured in the above groups. All the tested groups showed a sufficient amount of TSH. Moreover, it was observed that the pregnant women in the first trimester had a statistically significant lower level in comparison with pregnant women in the second/third trimesters and non-pregnant women who showed similar levels (Figure 7). Collectively, our data show that pregnant women during their last two trimesters, showing severe hair loss, displayed lower levels of Zinc, Hemoglobin, PCV, Ferritin, and vitamin B12 whilst no significant change in their vitamin D and TSH levels was observed as compared to non-pregnant women. On the other hand, pregnant women, with diffuse hair loss in their first trimester, showed only a significant decrease in TSH level in comparison with non-pregnant women. Collectively, it seems that TSH could be an important potential mediator for hair loss in the first trimester whilst Zinc Ferritin, and vitamin B12 could be important in the last two trimesters.

Discussion

Based on association studies, only riboflavin, biotin, folate, and vitamin B12 deficiencies have been linked with hair loss [4]. The process by which vitamin B12 deficiency could cause hair loss could be direct via its role in RBC production, being carriers of oxygen all over the scalp, or indirectly via its effect on thyroid gland function [4], [14]. Our study showed no significant difference in the average serum levels of Zinc, PCV, vitamin D, Hb, vitamin B12, and Ferritin between the control healthy non-pregnant women and pregnant women in their first trimester suffering from diffuse hair loss. This contradicts the study conducted by Baghel et al. who reported that vitamin B12 and iron levels were significantly lower in women in their first trimester of pregnancy compared to non-pregnant women [14]. However, our study showed that TSH levels differ significantly among pregnant women in their first trimester compared to non-pregnant women, which was in agreement with Zha et al. [19]. In our study, we noticed that vitamin B12 was positively correlated with TSH in the first trimester and negatively correlated with TSH in the second trimester, which is contrasting with the study by Bashetti et al. who studied the association of vitamin B12 and folic acid with thyroid hormones in pregnant Indian women with hypothyroidism and found that TSH levels were negatively associated with vitamin B12 levels in first and second trimesters [8], but perhaps this could be owing to that all the participants in their study were suffering from hypothyroidism. Whether a link between B12 and TSH levels exists, needs further investigation. On the other hand, the observed significant reduction in the levels of Zinc, PCV, Hb, vitamin B12, and Ferritin between pregnant women in their second to the third trimester compared to those in their first trimester and to control group could be explained by the increased demand of vitamins to support the growing baby. Knowing that most of the pregnant women included in the study had increased hair loss during their second to the third trimester compared to their first and even before pregnancy, and the fact that Zinc, vitamin B12, Hb, Ferritin, and PCV levels were all reduced significantly in the second to third trimester compared to the rest of the groups, indicates that diffuse hair loss may not be caused by vitamin deficiency but it gets worse upon deficiency in such vitamins. As hair loss in women affects their quality of life and their depression or anxiety status which in turn negatively affects both the mother and the fetus [20], where anxiety increases the risk for preterm birth, low birth weight, sooner gestational age, and a smaller head

circumference [21], then looking for the effect of vitamin supplementation during pregnancy on the event of hair loss in women could be useful to prevent any negative consequence of vitamin deficiency that could occur as a way to support the development of the fetus.

Conclusion

This study showed that Zinc, Ferritin, vitamin B12, PCV, and Hb levels decrease with the pregnancy period and this decrease was associated with the increase in diffuse hair loss. Thus, supplementation with such minerals and vitamin B12 during pregnancy would be indispensable to reduce this issue.

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List of Figures

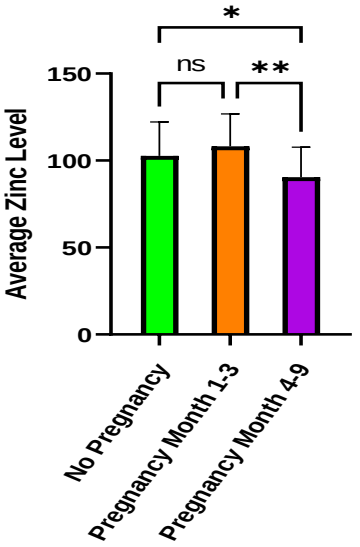

Figure 1 Zinc levels in different groups. ns: not significant, *p<0.05, **p<0.01

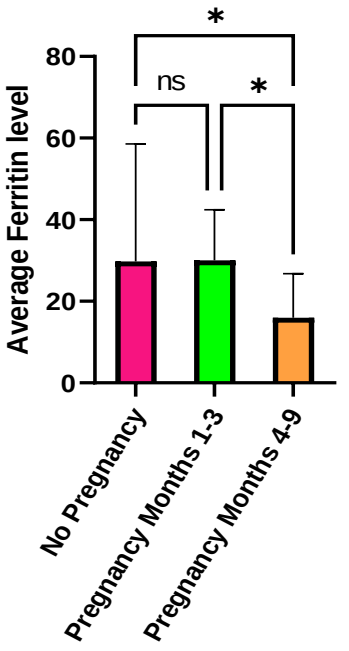

Figure 2 Ferritin levels in different groups. ns: not significant, *p<0.05

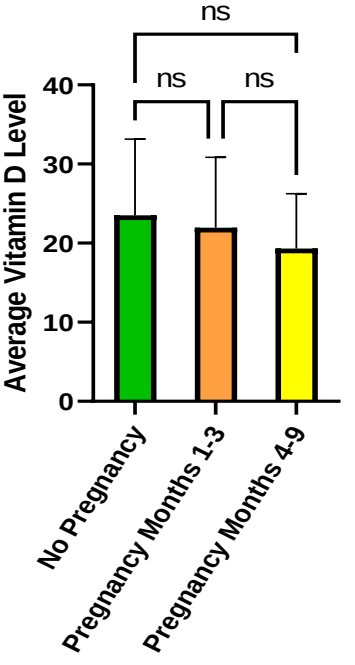

Figure 3 Vitamin D levels in different groups. ns: not significant

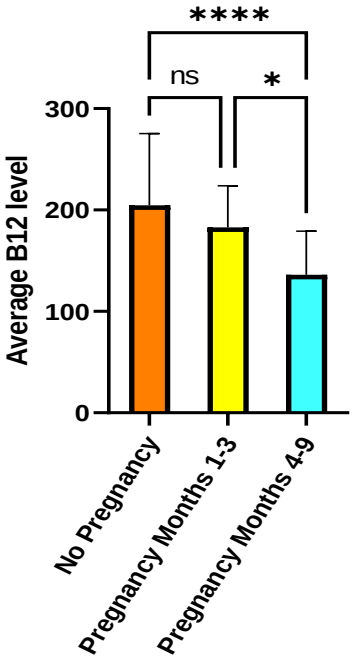

Figure 4 Vitamin B12 levels in different groups ns: not significant, *p<0.05, ****p<0.0001

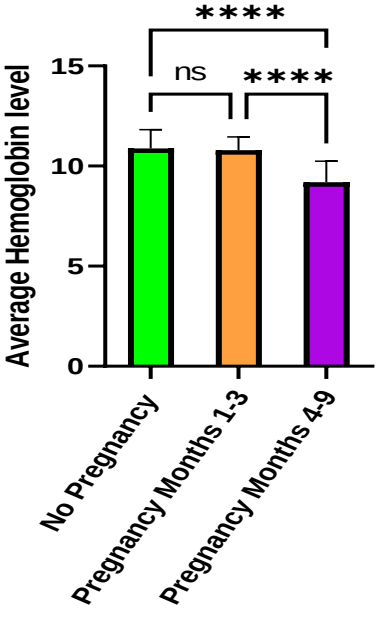

Figure 5 Hemoglobin levels in different groups ns: not significant, ****p<0.00001

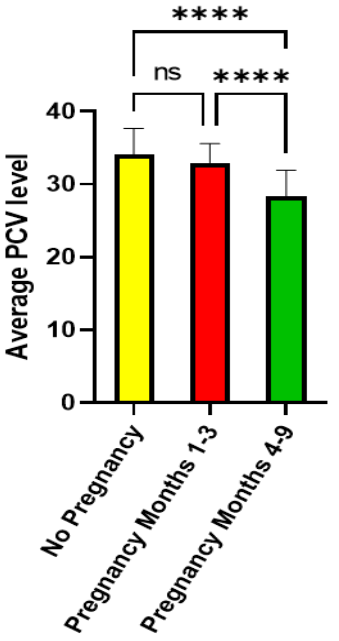

Figure 6 PCV levels in different groups ns: not significant, ****p<0.00001

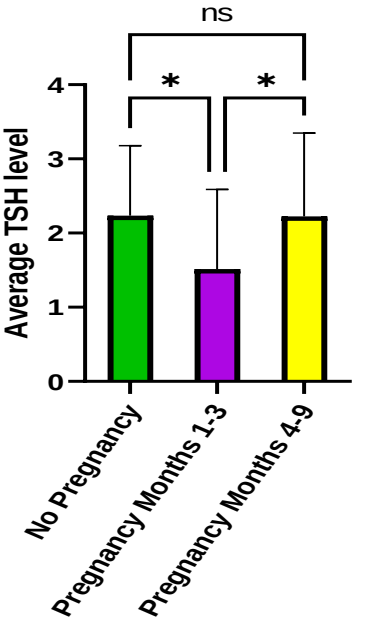

Figure 7 TSH levels in different groups ns: not significant,*p<0.05

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