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Effect of zinc deficiency on hair loss in pregnant women

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***Abstract*---**Zinc and iron, for example, are crucial trace elements for pregnant women's health. This study has been conducted for the evaluation of zinc and ferritin status of pregnant women since these elements have significant effects on health of the pregnant women as well as the growing embryo in Al Muthanna Province/ Iraq. Seventy five samples of this study were gathered from the three studied groups (Control, pregnant women with Hair Losing and non-pregnant women with Hair Losing) in the Central Health Laboratory of Al Muthanna Province through the period from November 2020 to May 2021, blood samples were collected for further analysis Conclusions : According to the findings of this study, serum zinc and ferritin levels are frequently low in pregnant women who complain of hair loss. Overall, zinc and ferritin insufficiency in Iraq is a major public health concern. Improving nutritional diversity aids in solving the risk among the study participants.

***Keywords*---**zinc deficiency, trace elements, hair loss, pregnant women, ferritin.

Introduction

Zinc is a mineral needed to develop the human body properly. Zinc is an essential element for many vital body functions such as cell cohesion, natural development and growth, performance of the immune systems and appetite stimulation (1). Though the outcomes such as growth, birth weight, development of neuro-behavioral behaviors, immunological performance and mortality (2) and a sufficient amount of zinc in pregnant mothers are necessary to ensure optimum

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motherhood, embryos and neonatal disease (3). Zinc deficiency may result from a variety of reasons including poor intakes of zinc for the diet, increased food insecurity, poor housing, distribution of food, inappropriate food, time to prepare, storage and infection in dietary conditions, and fiber/phytate presence (4). In pregnant mothers it is different from non-pregnant women to zinc nutrients, the most common concentration evaluation of which consists of plasma zinc. In the early stage of the pregnancy, plasma zinc levels start declining and they keep declining until the end, when approx. 35% lower in unpregnant women (5). The rate of the decline differs, and that could reflect the differing zinc status of women who are under study. Hemo dilution, decreased zinc protein hormonal changes throughout the pregnancy (6), and active transportation of zinc to the mother of the fetus have resulted in the decrease in zinc levels (5). As the plasma zinc level in embryos depends substantially on the plasma content of a mother's zinc, mother's zinc deficiency may lead to the same thing in embryos and neonates. in general, maternal nutrition is one of the most important effecting factors in mortality during pregnancy. During pregnancy, deficiency in embryos and neonates may lead to serious outcomes. Maternal zinc deficiency represents a problem of public health due to the fact that the zinc plays a key role in genetic potential expression, nuclear acid metabolic processes and protein molecules synthesizing (7) Consequently, zinc is crucial to foetal development. Inadequacies in other minerals like calcium and copper are correlated as well with pregnancy complications and fetal development. complications (8).

Ferritin can be defined as a protein which serum concentrations correlate with total iron reserves in human body, allowing it to be utilized as one of the reliable indicators in the diagnosis of iron insufficiency (9). The reserves of the iron in maternal organism are depleted due to the increase in the intake (by mother, fetus and placenta) in addition to hemodilution, causing the drop of the levels of ferritin. (10). The lack of a reduction in ferritin levels suggests that the fetoplacental unit is extracting less iron from the pregnant woman's blood, which could be linked to the development of intrauterine growth restrict (11). Due to the fact that the concentrations of the iron storage decline with the progression of the pregnancy, the levels of the ferritin reduce by 32% in the 1st, 39% in the 2nd, and 53% in the 3rd trimester (12). Between 30 and 32 weeks of the pregnancy, the concentrations of the ferritin are minimal, after which they stay in a steady level (10).

Ferritin can be defined as one of the major intra-cellular storage proteins, it keeps iron in an immobile and non-toxic form, and it was linked to several acute-phase events like the inflammations (13). Maternal sub-clinical infection could cause spontaneous membrane rupture by increasing ferritin levels as an acute phase reactant (14). According to certain research, ferritin levels can be utilized as a predictor of premature delivery (15).

Materials and Methods

Collection of Samples

All samples of this study were obtained from patients suspected with hair losing in the Central Health Laboratory of Al Muthanna Province through the period from November 2020 to May 2021. Blood samples were collected for further analysis .

Physiological Analysis

1. Ferritin : in this study ,Ferritin was measured by CLIA-iFlash 1800 (Shenzhen Yhlo Biotech Co., Ltd,China). Ferritin Chemiluminescence ImmunoAssay (CLIA) Test is achemiluminescence-based immunoassay for the quantitative detection of FTN in human serum or plasma using CLIA-iFlash 1800.All reagents of this test were provided by manufacturing company .Protocol of this test was followed up according manufacturing instructions.
2. Zinc determination test :This test was done based upon Johnsen and Eliasson method (16),Where zinc of all studied groups was estimated colorimetrically by utilizing the LTA-s.r.l.(Milano-Italy) Kit on AUTOMATIC ANALYZER BTS-350 (BioSystems ,Spain instrument this test is one of thee direct colorimetric assays, it is based upon 5 –Br-PAPS approach without sample de-proteinization. The determination of the zinc has been based upon zinc reaction with 5-Br –PAPS at the alkaline PH in buffered media, forming stable coloured complex .The colour intensity has been proportionate to zinc concentration in the sample. $Zn2^{+}$-complex absorbance is evaluated at 578nm by SEMI-AUTOMATIC ANALYZER BTS-350.Wavelength range of sensitivity: 520-570nm.

Statistical analysis

The statistical analyses of results have been performed with the use of the SPSS (v. 22). The results have been represented by the mean ± S.D. Significance of the differences were assessed through the independent t-test, Anova, LSD. Pearson correlation was used to compare among studied parameters of this work. A P value of ≤ 0.05 has been considered to be statistically significant (17).

Results

Seventy five samples of this study were obtained from the three studied groups, 25 Controls, 25 pregnant women with Hair Losing and 25 non-pregnant women with Hair Losing.

Table (1): Comparison of study parameters (Ferritin and Zinc) among the studied groups (Control, pregnant women with Hair Losing and non-pregnant women with Hair Losing)

Parameters	Hair Losing (pregnant) N=25	Hair Losing (non-pregnant) N=25	Control (non-pregnant) N=25	P_{value}
Ferritin (ng/mL)	22.4±13.9	30±15	36.18±19.17	a- 0.015* b- 0.007* c- 0.315 d- 0.101
Zinc (µg/dL)	65±14.1	85±21.16	107.4±10	a- <0.0001*

				b- <0.0001* c- <0.0001* d- <0.0001*

* represents significant difference at p<0.050. letters (a, b, c and d) represent statistical analysis among studied groups, as following: a- among all the studied groups; b- between Control group and Hair Losing (pregnant) group; c- between Control group and Hair Losing (non- pregnant) group; d- between Hair Losing (non- pregnant) group and Hair Losing (pregnant) group.

As it appears from table (1) there was a significant differences among all the studied groups and between Control group and hair Losing (pregnant) group in Ferritin levels (ng/mL), but there was no significant differences between Control group and Hair Losing (non- pregnant) group and between hair Losing (non-pregnant) group and Hair Losing (pregnant) group.

While Zinc levels (µg/dL) shows significant differences between all mentioned groups, among all the studied groups; between Control group and Hair Losing (pregnant) group; between Control group and Hair Losing (non- pregnant) group; and finally between Hair Losing (non- pregnant) group and Hair Losing (pregnant) group. Table (2) shows no significant differences among the studied groups according to the 3 age groups (≤18, 19-35 and ≥36) in the levels of Ferritin and Zinc. The study shows a clear decrease in the level of zinc and ferritin in pregnant women compared to the other groups under the experiment (Fig1).

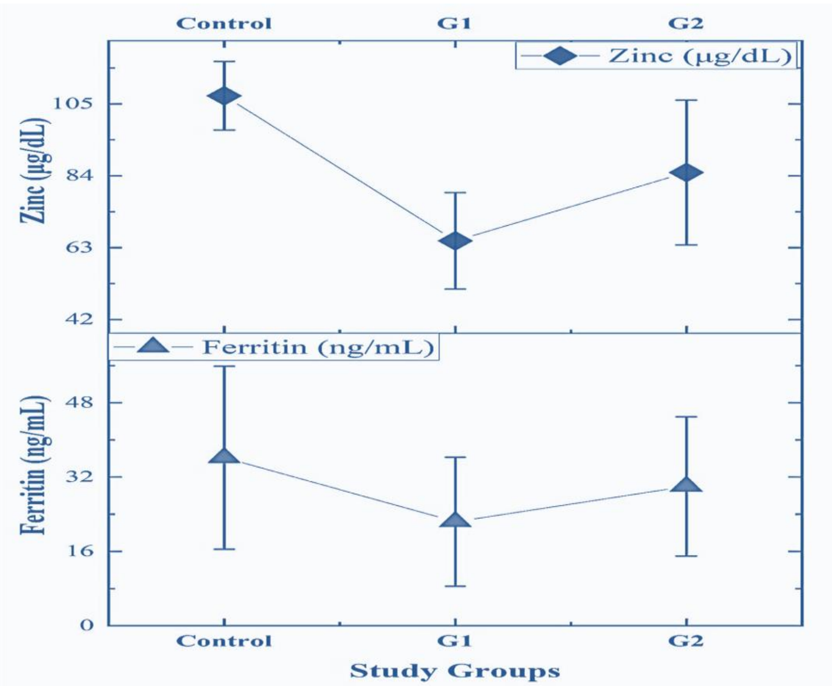

Fig. (1): Comparison of study parameters ((Ferritin and Zinc)) among the studied groups (Control, pregnant women with Hair Losing (G1) and non-pregnant women with Hair Losing (G2))

Table (2): Comparison of study parameters (Ferritin and Zinc) among the studied groups (Control, pregnant women with Hair Losing and non-pregnant women with Hair Losing) according to age

Parameters	Age Groups	Hair Losing (pregnant) N=25	Hair Losing (non-pregnant) N=25	Control (non-pregnant) N=25
Ferritin	≤18	12.14±7.7	38.6±12.2	27.3±13.3
	19-35	24.7±14.8	25±9	41.4±19.5
	≥36	21.4±0.7	30.6±18.3	33.5±22
	P value	0.270	0.180	0.319
Zinc	≤18	58.7±23.9	100.3±14.7	110±12
	19-35	66.6±12.4	87.8±20.8	107.7±9.4
	≥36	62±7	80.3±23.7	103.4±9.6
	P value	0.584	0.194	0.514

* represents significant difference at p <0.05.

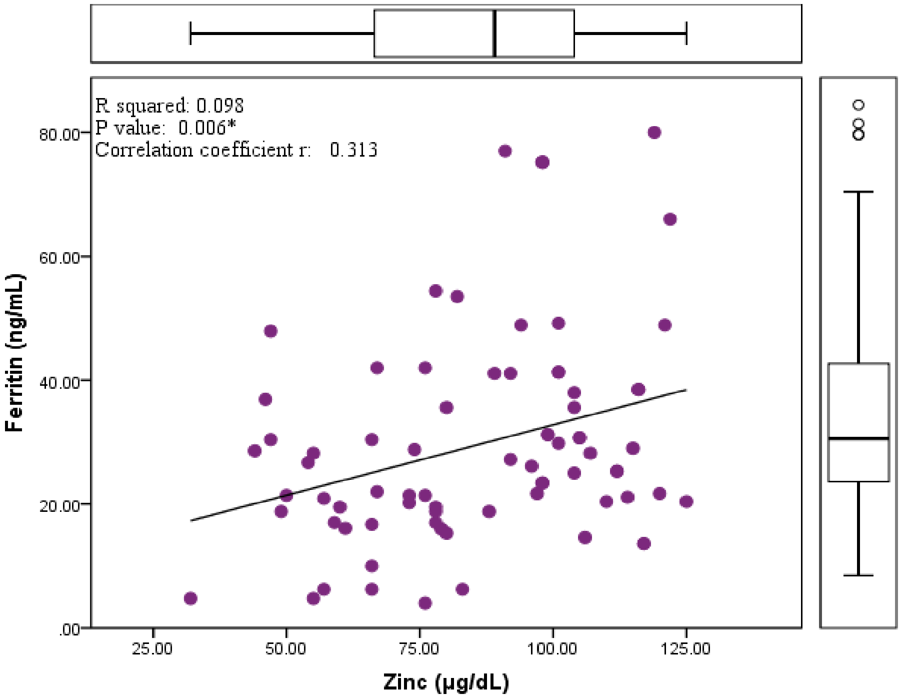

Fig. (2): Correlation between Ferritin and Zinc concentrations in all studied groups (Control, Pregnant women with hair losing, non- Pregnant women with hair losing) by using Box plot and scatter diagram

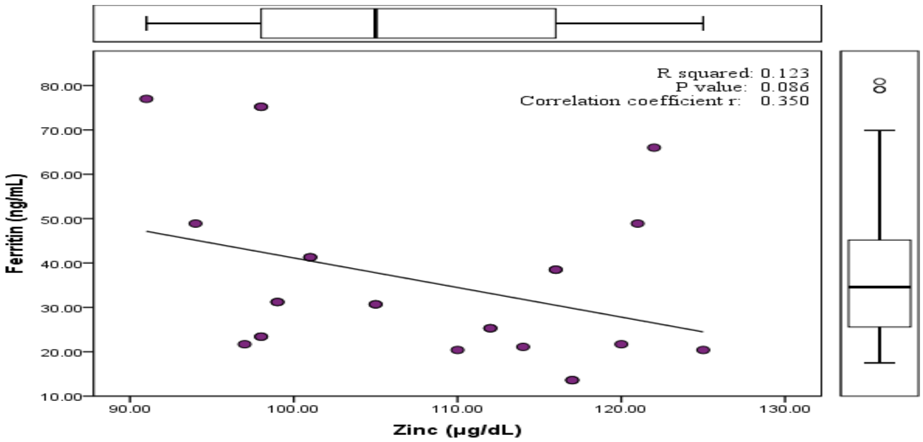

Fig. (3): Correlation between Ferritin and Zink concentrations in Control group (non-pregnant and without hair losing) with by using Box plot and scatter diagram.

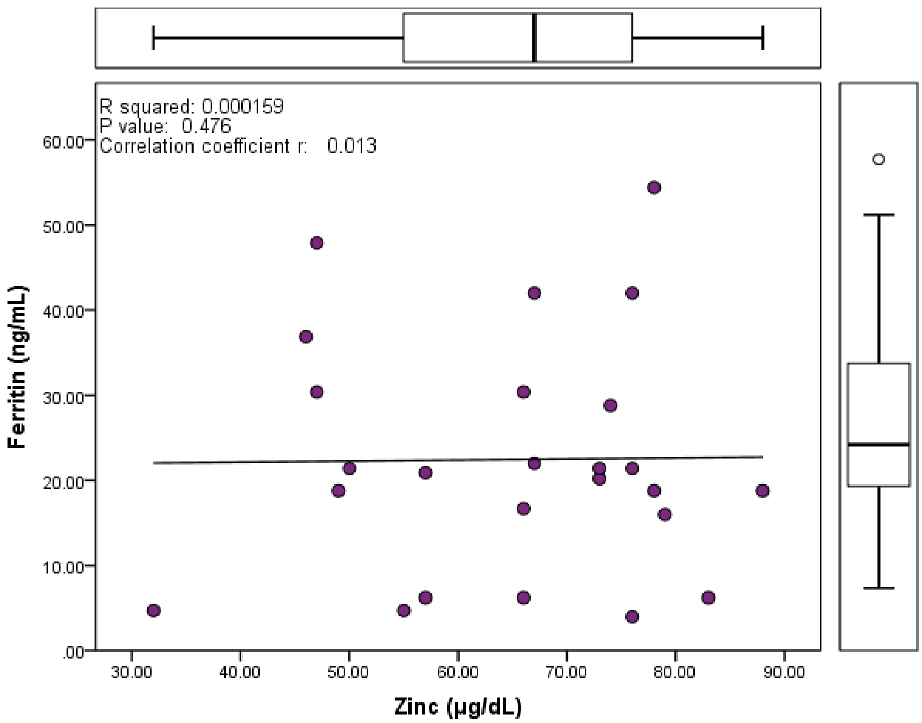

Fig. (4): Correlation between Ferritin and Zinc concentrations in Pregnant women with hair losing group by using Box plot and scatter diagram

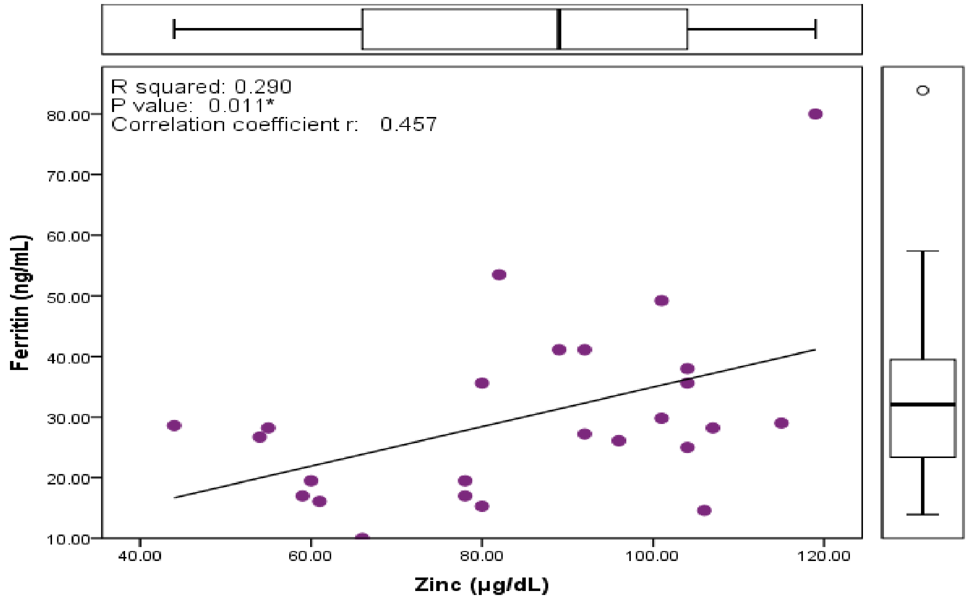

Fig. (5): Correlation between Ferritin and Zinc concentrations in non- Pregnant women with hair losing group by using Box plot and scatter diagram

Results have shown that there has been a positive correlation (the correlation is statically significant) between Ferritin and Zinc concentrations in all studied groups (Control, Pregnant women with hair losing, non- Pregnant women with hair losing) (Fig 2) and moderate positive correlation between Ferritin and Zinc concentrations in non- Pregnant women with hair losing group (Fig 5). The results also showed that the correlation is not statically significant between Ferritin and Zinc concentrations (P value = 0.086 and 0.476) in control group (non-pregnant and without hair losing) (fig 3) and in pregnant women with hair losing group (fig 4) .

Discussion

Pregnant women are especially susceptible to iron deficiency anemia during the first and second trimesters. Low serum ferritin was mostly owing to increased iron requirements, as well as increased blood volume, to sustain maternal tissues, placental, and fetal needs (18). Because of the increased need for iron to transfer oxygen to diverse tissues during intrauterine life, iron insufficiency is frequent during pregnancy. Any drop in ferritin levels leads to low tissue and hair follicle oxygenation, resulting in hair thinning and loss. Low serum ferritin levels could result in further complications like the low birth weight (19) and fetal stress (18).

Iron deficiency is diagnosed by a drop in serum ferritin levels, which is a very specific observation. The most important lab test for iron insufficiency is serum ferritin (20). The average serum ferritin level in patients has been considerably lower compared to it in the healthy people in this investigation. Moreover, patients were more likely than the control group to have a low blood ferritin level. The findings of this study suggest that serum ferritin levels could be involved in the etiology and pathogenesis of diffuse hair loss.

Zinc used by the fetus may also help to lower maternal zinc levels. Nonetheless, pregnant women's zinc levels were consistently lower than their non-pregnant counterparts (21). Pregnant women exhibited a higher mean apparent zinc absorption than nonpregnant women because they have excreted less zinc in their feces. Sadly, the balance approach doesn't distinguish between the dietary zinc that is not absorbed and zinc that is produced by the body. As a result, it's unclear whether the pregnant women's higher mean apparent absorption values reflect enhanced dietary zinc absorption or lower endogenous zinc excretion (21).
Zinc is an important micronutrient that aids in the production of proteins and nucleic acids. Zinc has been shown to slow hair loss and speed up hair follicle regrowth (22). For example, acrodermatitis enteropathica, a rare hereditary condition caused by zinc malabsorption, manifests clinically as hair loss (22). Kil *etal*. Have found that serum zinc levels in patients with female pattern hair fall were considerably lower than in healthy people. Disturbances in zinc metabolism may have a role in etiological factors of hair loss, according to Kil *et al*. (22). While Tamer et al. discovered that the mean serum zinc level in patients as well as control group was statistically identical, only 5 sick and 2 healthy people had a low serum zinc content, and the data demonstrated no link between serum zinc levels and hair fall (23).

Our findings contradict those of previous studies, such as Farah et al., who found that the true cause of hair loss in women changes according to age groups, with women between the ages of 17 and 33 sharing a large drop in ferritin (24). According to the statistically significant correlation between Ferritin and Zinc concentrations in all our studied groups, this agrees with Rasool *et al* study of serum zinc (S. zinc) levels and their relationship to the anemia related to the iron deficiency in the pregnant women, who came to the conclusion that individuals with iron deficiency anemia have considerably reduced concentration of S. zinc, which has been strongly positively related to the Hb, erythrocytes, and HCT and negatively correlated with serum iron (25). Dhaher *etal* found no considerable correlations between zinc and iron levels in the serum as well as the hair (26).

Zinc and iron fight for absorption in the intestine, but their post-absorption interactions are less obvious (27). Zinc and iron compete for absorption in the intestine. There are evidences that excess of iron decreases zinc absorption in the case where both minerals are intercropping in aqueous solutions at amounts routinely utilized in the supplements (28) and that too much zinc prevents iron absorption (29). Iron-zinc supplementation has been beneficial in boosting Hb and serum ferritin values amongst the iron deficient women in early pregnancy, but not amongst the iron sufficient ones, according to Saaka (30).

References

1. Nemati M, shakhse kalai M. feeding after renal transplantation. 2ed ed. Mashhad: Mashhad University of Medical Sciences; 2011.

2. Railey AM, Micheli TL, Wanschura PB, Flinn JM.Alterations in fear response and spatial memory in pre- and post-natal zinc supplemented rats: remediation by copper. Physiol Behav. 2010 May; 100(2):95-100.
3. Moran VH, Skinner AL, Medina MW, Patel S, Dykes F, Souverein OW, Dullemeijer C, Lowe NM The relationship between zinc intake and serum/plasma zinc concentration in pregnant and lactating women: A systematic review with dose-response meta-analyses. J Trace Elem Med Biol. 2012 May 19.
4. Bruno B, Ian D, Lena D, Olivier F. Conclusions of the joint WHO/UNICEF/ IAEA/IZiNCG interagency meeting on zinc status indicators. Food Nutr Bull. 2007;28(3):480–4.
5. Tamura T,Goldenberg RL.Zinc nutriture and pregnancy outcome. Nutr Res.1996;16:139-181.
6. Jameson S.Effects of zinc deficiency in human reproduction. Acta Med Scand Suppl.1976;593;1-89.
7. Saskia JMO, Clive EW, Robert EB. The need for maternal zinc supplementation in developing countries. J Nutr 2003; 133: 817 s – 827 s.
8. Villar J, Merialdi M, Gülmezoglu AM, Abalos E, Carroli G, Kulier R, de Oni M. Nutritional interventions during pregnancy for the prevention or treatment of maternal morbidity and preterm delivery:An overview of randomized controlled trial. J Nutr 2003; 133: 1606 s-1625 s.
9. Uberos J, Munoz A and Molina A. Blood ferritin levels in the pregnant women as estimation of the low birth weight? Prenat Neonat Med2000; 5: 177–81.
10. Mila{inovi} Lj. Fiziologija trudno}e. Kosmos, Beograd2005; 282–92.
11. Mandruzzato G. Intrauterine growth restriction (IUGR): Guidelines for definition, recognition and manage ment. Archives of perinatal medicine 2008; 14 (4): 7–8.
12. Lee JI, Kang SA, Kim SK, Lim HS. A cross sectional study of maternal iron status of Korean women during pregnancy. Nutr Reser 2002; 22 (12): 1277–88.
13. Chen X, Scholl TO, Stein TP. Association of elevated serum ferritin levels and the risk of gestational diabetes mellitus in pregnant women: The Camden study. Diabetes Care 2006;29:1077-82. doi: 10.2337/diacare.2951077.
14. Zhang Q, Ananth CV, Li Z, Smulian JC. Maternal anaemia and preterm birth: a prospective cohort study. Int J Epidemiol. 2009;38:1380-9. doi: 10.1093/ije/dyp243.
15. Abdel-Malek K, El-Halwagi MA, Hammad BE, Azmy O, Helal O, Eid M, et al. Role of maternal serum ferritin in prediction of preterm labour. J Obstet Gynaecol. 2018;38:222-25.
16. Johnsen, R eliasson.Evaluation of acommercially available kit for the colorimetric determination of zinc .Int J Androl 1987;10(2):435-40.
17. Danial WW.Biostatistics :Afoundation for analysis in the health science 3rd.John wiley,1983.
18. Abdullah,H.D. Estimation of vitamin d3 and ferritin in pregnant woman and relationship with hair loss. EurAsian Journal of BioSciences Eurasia J Biosci 14, 1877-1880 (2020).
19. Tabrizi FM, Barjasteh S (2015) Maternal hemoglobin levels during pregnancy and their association with birth weight of neonates. Iranian journal of pediatric hematology and oncology, 5(4): 211.

20. Trost LB, Bergfeld WF, Calogeras E. The diagnosis and treatment of iron deficiency and its potential relationship to hair loss. J Am Acad Dermatol 2006; 54: 824-44.
21. Swanson C.A and King J.. Zinc Utilization in Pregnant and Nonpregnant Women Fed Controlled Diets Providing the Zinc RDA. Journal of Nutrition · May 1982. DOI: 10.1093/jn/112.4.697 · Source: PubMed
22. Kil MS, Kim CW, Kim SS. Analysis of serum zinc and copper concentrations in hair loss. Ann Dermatol 2013; 25: 405-9.
23. Tamer F, Yuksel, M and Karabag, Y. Serum ferritin and vitamin D levels should be evaluated in patients with diffuse hair loss prior to treatment. Advances in Dermatology and Allergology.2020.
24. Farah,H.S. Abu hajleh, M. Shalan,N, Alassi,G. Alqaisi, T. 2017. The association between the levels of Ferritin, TSH, Zinc, Hb, vitamin B12, vitamin D and the hair loss among different age groups of women: A retrospective study. INTERNATIONAL JOURNAL OF PHARMACEUTICAL RESEARCH. doi.org/10.31838/ijpr/2021.13.02.038
25. Rasool,S. Zaman,B, and Abdulah, DM. 2020.Serum zinc levels in iron deficiency anemia, non-iron deficiency anemia, and normal pregnant women and its correlation with iron status and hematological parameters.Medical J.Babylon. 2020 17 : 1 : 103-108
26. Dhaher, SA, Yacoub, AA and Jacob,AA. Estimation of zinc and iron levels in the serum and hair of women with androgenetic alopecia: Case–control study. *Indian J. Dermatology*.2018 DOI: 10.4103/ijd.IJD_624_16
27. Donangelo,CM. Woodhouse, LR, King,SM. Viteri, FE and King, JC. Supplemental Zinc Lowers Measures of Iron Status in Young Women with Low Iron Reserves. *The Journal of Nutrition*, Volume 132, Issue 7, July 2002, Pages 1860–1864,
28. Whittaker, P. (1998) Iron and zinc interactions in humans. Am. J. Clin. Nutr. 68:442S–446S. Google ScholarCrossrefPubMed
29. Aggett, P. J., Crofton, R.W., Khin, C., Gvozdanovic, S. & Gvozdanovic, D. (1983) The mutual inhibitory effects on their bioavailability of inorganic zinc and iron. Prasad, A. S. Cadvar, A. Brewer, G. J. Agget, P. J. eds. Zinc Deficiency in Human Subjects :117–124 Alan R. Liss New York, NY.
30. El-Said, K., Syamsuddin, S., Idris, I., Limoa, E., Pelupessy, N., & Syam, A. (2020). The effectiveness of prenatal gentle yoga on the recovery of depression level in primigravid and multigravid pregnant women. *International Journal of Health & Medical Sciences*, *3*(1), 92-97. https://doi.org/10.31295/ijhms.v3n1.169
31. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). Health and treatment of diabetes mellitus. *International Journal of Health Sciences*, *5*(1), i-v. https://doi.org/10.53730/ijhs.v5n1.2864