2022 3 SEBHA UNIVERSITY JOURNAL OF PURE & APPLIED SCIENCES VOL.21 NO.
DOI: 10.51984/JOPAS.V21I3.2626

مجلة جامعة سبها للعلوم البحتة والتطبيقية
Sebha University Journal of Pure & Applied Sciences

Journal homepage: www.sebhau.edu.ly/journal/index.php/jopas

تقدير مستوى الزنك في النساء الحوامل اللاتي يعانين من فقر الدم بعوز الحديد وعلاقاته بتركيز الهيموجلوبين

*هدى صالح الدهماني[1] و عبدالوهاب الذيب[2] و مبروكة محمد الزوي[1]

[1]قسم العلوم الطبية، كلية الهندسة والتكنولوجيا، جامعة سبها، براك الشاطئ، سبها، ليبيا
[2]قسم علوم المختبرات الطبية، كلية التكنولوجيا الطبية، جامعة طرابلس، ليبيا

الملخص

يعتبر فقر الدم الناتج عن نقص الحديد من المشاكل الصحية المنتشرة بكثرة حول العالم وخاصة في الدول النامية، ويعد نقص الحديد الأكثر شيوعاً لدى النساء الحوامل. الزنك يعتبر عامل مساعد للعديد من الأنزيمات في الجسم، وله دور مهم في أيض الحديد، وله دور مهم في إنتاج خضاب الدم و كريات الدم الحمراء، بالتالي نقصه مرتبط بفقر الدم بعوز الحديد. الهدف من **الدراسة:-** تهدف هذه الدراسة الى تقدير تركيز الزنك في النساء الحوامل المصابات بفقر الدم بعوز الحديد و علاقته بالقيم الدموية لديهن .**عينة الدراسة:-** أجريت هذه الدراسة على 152 إمراءة من النساء الحوامل: قسمت إلى مجموعتين حسب مستوى الحديد. المجموعة الأولى نساء حوامل مصابات بفقر الدم بعوز الحديد كان عددهن 90 إمرأة . المجموعة الثانية (المجموعة الضابطة) نساء حوامل غير مصابات بفقر الدم بعوز الحديد و كان عددهن 62 إمرأة. **المواد و الطرق :-** تم تجميع البيانات من المشاركات في الدراسة عن طريق الاستبيان و نتائج الاختبارات المعملية، شملت هذه الاختبارات عد الدم الكامل و المؤشرات الدموية و كذلك الاختبارات الكيميائية التي تضمنت قياس تركيز الحديد والزنك في المصل و مخزون الحديد. **النتائج:-** أوضحت النتائج ان متوسط تركيز الزنك في النساء الحوامل المصابات بفقر الدم بعوز الحديد (44.4 ± 1.40 µg/dl) أقل معنوياً منه في المجموعة الضابطة (53.5 ± 2.30 µg/dl)، كما تبين وجود علاقة ارتباط موجبة بين الزنك وبين خضاب الدم (r = 0.303, P = 0.000). نستنتج من هذه الدراسة ان نقص الزنك أكثر إنتشاراً في النساء الحوامل المصابات بفقر الدم بعوز الحديد. وتربطه علاقة موجبة مع تركيز الهيموجلوبين والحديد.

الكلمات المفتاحية:

الحمل
فقر الدم
فقر الدم بعوز الحديد
الزنك
مخزون الحديد

Estimation of Zinc level in anemic pregnant women and its relation to hemoglobin concentration

Huda Saleh Aldahmany[a], Abdulwhab Aldei[b], Mabroukah Mohamed Alzwayi[a]

[a] Medical Science Department, Faculty of Engineering and Technology, Sebha University, Brack-Alshati, Sabha, Libya
[b]Department of Medical Laboratory Science, Faculty of Medical Technology, Universityof Tripoli

Keywords:

Anaemia
Iron
Iron deficiency anaemia
Pregnant women
Zinc

ABSTRACT

Background: Iron deficiency anaemia (IDA) is a major public health problem especially in underdeveloped and developing countries. IDA is the most prevalent nutrient deficiency during pregnancy. Zinc is the co-factor of several enzymes and plays a role in iron metabolism, so zinc deficiency is associated with IDA. It is primary immunologic function in pregnancy and it also plays a critical role in hemoglobin synthesis and erythropoiesis. **Objective:** To investigate the prevalence of zinc deficiency in pregnant women with iron deficiency anemia, and its relation with the haematological parameters. **Population:** This study comprised 152 pregnant women; Women were divided into two groups according to the level of iron. Pregnant women with iron deficiency anaemia (n = 90) and pregnant women without iron deficiency anemia (n = 62). **Materials and Methods:** Data were collected using questionnaires and laboratory analyses of blood samples. The hematological parameters evaluated included haemoglobin, hematocrit, erythrocyte count, mean

*Corresponding author:
E-mail addresses: dahmanhuda3@gmail.com,(A. Aldei) abdula1959@yahoo.com ,(M. M. Alzwayi) mab.alzwayi@sebhau.edu.ly
Article History : Received 10 February 2022 - Received in revised form 20 May 2022 - Accepted 20 June 2022

corpuscular hemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC), Whereas biochemical analysis include serum ferritin, serum iron and zinc levels. **Results:** The mean zinc level was (44.4 ± 1.40 µg/dl) significantly lower in the IDA group than (53.5 ± 2.30 µg/dl) in those without IDA group ($p < 0.05$), and showed that Hb has a positive correlation with zinc ($r = 0.303$, $P = 0.000$) and other parameters. In short; zinc deficiency is more prevalent in women with IDA.

Introduction

Pregnancy is a period of increased metabolic demands due to physiological changes in the woman and the requirements need of the growing of fetus. [1]

Deficiencies of minerals have been associated with pregnancy wastage, congenital anomalies, pregnancy induced hypertension, placental abruption, premature deliveries, still births and a high incidence of low birth weight babies. [2]

Iron deficiency anaemia (IDA) is the most common nutritional deficiency in pregnant women worldwide, with an impact on maternal and fetal morbidity and mortality. It is regarded as the most important preventable cause of perinatal complications. [3]

Zinc is an essential mineral and important for human health, it is important for many basic metabolic processes and hence essential for optimal growth, it plays a critical role in haemoglobin synthesis and erythropoiesis, so it plays a vital role in the etiology of anaemia.[4]

Therefore, zinc and iron are the micronutrients that their requirements increase with pregnancy, pregnant women worldwide are frequently iron and zinc deficient. Iron deficiency increase maternal and infant morbidity and mortality, decrease resistance to infection, and impair mental and psychomotor development of children. Zinc deficiency can impair growth and cognitive and immune function and may contribute to complications during pregnancy and retard fetal growth. [4]

The World Health Organization (WHO) defines anaemia in pregnancy as haemoglobin concentration of less than 11.0 g/dl and less than 10.0 g/dl during the postpartum period. According to this definition, anemia is Hb concentration less than 11 g/dl during weeks 1-12 (first trimester) and 29-40 (third trimester) of gestation, and less than 10.5 g/dl during weeks 13–28 (second trimester). [5]

Study was done on 400 pregnant women whom referred to Zahedan Ghods hospital, demonstrated that the prevalence of zinc deficiency among the pregnant women was 49%, that zinc deficiency had correlation with mother age, term of pregnancy and iron consumption, but no correlation was found with numbers of deliveries and education. [6]

The study included 43 IDA patients and 43 healthy control subjects. All patients were asked to provide a detailed history and were subjected to a physical examination. Serum zinc levels were lower in anemic patients. [7]

In other study, zinc concentrations of 34 individuals diagnosed with IDA, 20 non-iron deficiency anemic pregnant women, and 32 non-anemic apparently healthy individuals were measured. Zinc was significantly lower in the IDA group (49.59 ng/dL) compared to the healthy controls (55.78 ng/dL). The study showed that S. zinc has a positive correlation with Hb. In addition, zinc had a positive correlation with hematocrit. [4]

The aim of this study was to estimate the level of zinc in pregnant women with iron deficiency anemia, and its relation with the haematological parameters.

Material and methods

This study was conducted on 152 pregnant women attending Barak General Hospital, and that during the time period from 29/12/2019 to 24/3/2020, at different stages of pregnancy, their ages a ranged between 20 – 43 years, questionnaire and consent form for participate in this study was filled for each subject. 5 ml of blood samples were collected from each of them; 2 ml in EDTA tube for measurement of Hb level and complete blood count (CBC), the remaining 3 ml was collected in plain tube for determination of Iron, Zinc and ferritin levels. CBC estimated by BC-3000Plus Auto Haematology Analyser; Mindray, serum iron, zinc estimated by Photometer 4040 $_{v5+}$ and ferritin estimated by Ichroma $^{TM.}$

Statistical analysis: Data were analysed by SPSS Version 20, Results were given as mean ± standard error (SE), a parametric independent t test was performed to detect differences between groups, person correlation was applied to show the relation between them and ANOVA were applied to show the difference between trimesters of pregnancy.

Results

From the results, the study group was divided into two groups according to the iron and hemoglobin concentration: the first group contained 62 women whose hemoglobin level was normal. The second group contained 90 women whose hemoglobin was less than normal, as shown in figure (1).

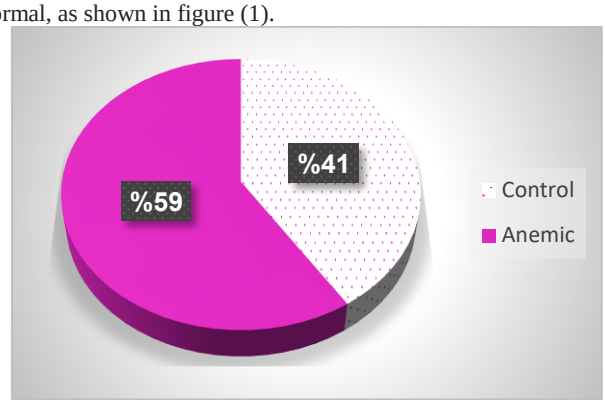

Fig (1) shows the percentage of anemic and control groups in this study

The independent t- test used to compare between the two groups in different parameters. No statistical difference was found between them in age, BMI, systolic blood pressure and diastolic blood pressure as shown in table (1).

Table (1): shows the difference between normal and anemic groups in different parameters

Variable	Anaemic group (N=90)	Control group (N=62)	P- value
Age (years)	29.59 ± 0.58	30.35 ± 0.70	**0.40**
BMI (kg/m2)	28.20 ± 0.59	29.07 ± 0.64	**0.33**
Systolic blood pressure (mmHg)	108.11 ± 1.35	105.65 ± 1.52	**0.23**
Diastolic blood pressure (mmHg)	70.44 ± 0.99	69.03 ± 1.12	**0.35**

On the other hand, significant difference was found between the two groups in case hematological profile, ferritin, iron and zinc as shown in table (2), as they were lower in anemic group than non-anemic.

Table (2): shows the difference between normal and anemic groups in hematological profile, ferritin, iron and zinc

Variable	Anaemic group (N=90)	Control group (N=62)	P- value
	(mean ± Std error mean)		
RBC (10^{12}/L)	3.8 ± 0.04	4.1 ± 0.04	**0.000****
HGB (g/dl)	9.8 ± 0.09	12.2 ± 0.11	**0.000****
HCT (%)	31.0 ± 0.23	36.5 ± 0.31	**0.000****
MCV (f L)	81.1 ± 0.85	89.4 ± 0.61	**0.000****
MCH (pg)	25.5 ± 0.34	29.7 ± 0.24	**0.000****
MCHC (pg)	31.5 ± 0.14	33.3 ± 0.11	**0.000****
Serum iron (µg/dl)	48.6 ± 2.33	75.5 ± 4.51	**0.000****
Ferritin (ng/ml)	9.84 ± 0.59	17.87 ± 1.72	**0.003****
Zinc (µg/dl)	44.4 ± 1.40	53.5 ± 2.30	**0.001****

** highly significant.

In addition: the relation between Hb and the other parameters was studied using person correlation, significant correlation found with most of them as shown in table (3). There was an inverse relation between the severity of anaemia and zinc activities. Zinc levels decreased as the haemoglobin value decreased (severity of anaemia increased) .

Table (3): shows the correlation between hemoglobin and hematological profile, ferritin, iron and zinc in all pregnant women

Variables	Pearson correlation	P- value
RBC (10^{12}/L)	0.432	0.000**
HCT (%)	0.964	0.000**
MCV (f L)	0.632	0.000**
MCH (pg)	0.730	0.000**
MCHC (pg)	0.751	0.000**
Serum iron (µg/dl)	0.317	0.000**
Ferritin (ng/ml)	0,442	0.000**
Zinc (µg/dl)	0.303	0.000**

** highly significant

Pregnant women were divided into three groups according to the period of pregnancy (first, second and third trimesters), One-way ANOVA was applied to compare between them. The results show significant difference in Hb, ferritin and Zinc, as they were decreased as period of pregnancy go up, with no significant difference in iron concentration as shown in fig (2, 3).

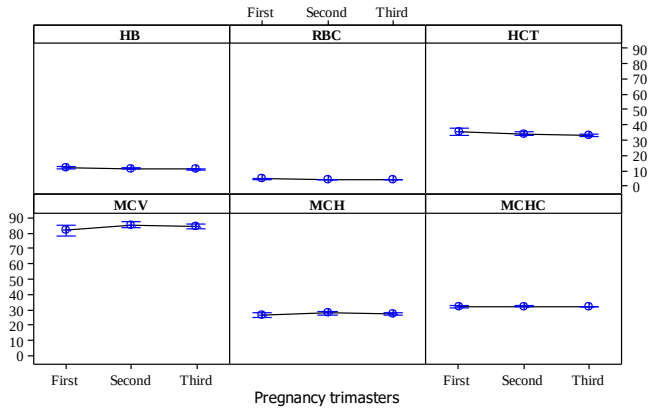

Fig (2) shows the difference in haematological profile during three stages of pregnancy.

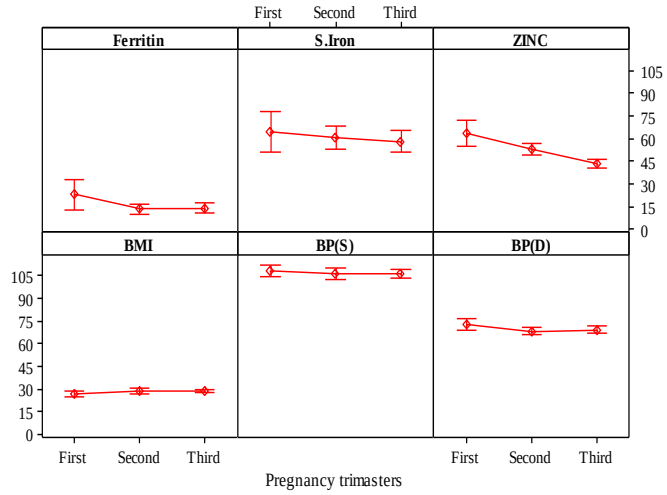

Fig (3) shows the difference in Iron, zinc and during three stages of pregnancy.

Discussion:-

In pregnancy, anaemia is a health problem worldwide [8] which is defined according to the WHO as haemoglobin values below 11 g/dL in pregnancy [8, 9]. As the gestational week goes up, it is usual to develop physiological anaemia as a result of increasing plasma volume [10]. In addition, the nutrient, energy and oxygen requirements of the foetus are increased. It is related to increased maternal and child mortality and morbidity in low-income countries [11]

In our study, out of 152 pregnant women 90 of them were anaemic (Hb Less than 11) with the prevalence of 59%, This finding was consistent with a study in Sudan were the prevalence was 53.0% [12] and in Jeddah, Saudi Arabia where it was 55.6% [13] , but higher than the studies conducted in Ethiopia [14], and Uganda [15]. However, it is lower than that found by A-Elbasit et al in Rafha city in Saudi Arabia where they found the prevalence of anaemia among pregnant women more than 70% [16]. Such geographical variations of anaemia across the countries might be attributable to the difference in food hepatis and cultural beliefs about dietary consumption during pregnancy, the occurrence of communicable diseases and the difference in the availability of healthcare facilities. As it is more prevalence in third trimester of pregnancy, that could be related to increase demand by foetus [17].

35.6% of the anaemic PW was with IDA, and most of which at the third trimester, that could be related to increase demand by foetus on metabolites and minerals. This was in agreement with Gupta 2017, who demonstrated that pregnant females in their third trimester of pregnancy had the highest prevalence of ID. Iron deficiency is the most common nutritional deficiency worldwide affecting women and young children in developing countries. As there are multiple etiological factors like malnutrition, low socioeconomic status, high-fiber diet, milk allergies, and parasitic infections, it is not a wonder to find a significant association between zinc deficiency and iron deficiency [18]

The other finding of this study is the significant decrease in zinc level in pregnant women with anemia compared with non anemic pregnant and it is positively correlated to iron and ferritin levels this was in agreement with Abdo Soliman et al (2019) [19]. Inadequate take of zinc during pregnancy has been related to adverse pregnancy outcomes including abortion, foetal neural tube defects, membrane rupture, preterm delivery, prolonged labour and stillbirth and risk of maternal and infant mortality. Other risk factors of zinc deficiency are diarrheal disease, malabsorption syndromes, parasitosis, hot and humid climate, rapid multiplicative cell growth (pregnancy, infancy, and adolescence), lactation and genetic disease. Zinc deficiency is primarily related to the poor zinc status of the diet [20]. The association between zinc deficiency and iron deficiency may be due to nutritional insufficiency of both elements or malabsorption.

Our study show that decrease in iron, zinc and ferritin were more as pregnancy go up, as the foetus grow up and more nutrients needed, this finding were in agreement with many studies such as Khoushabi et al (2016) [21] and Gupta et al (2017) who demonstrate that pregnant females in their third trimester of pregnancy had the highest prevalence of ID [17]. Zinc and iron are the most important trace elements in homeostasis. Iron and zinc have important roles in heme structure, iron absorption, iron transport and exhibit competitive inhibition in transport and bioavailability [15-16]. Zinc acts as a catalyst in heme metabolism being part of GFi-1B zinc finger protein structure, which is a major regulator in erythroid cell growth by modulating gene expression specific to erythroid series, performs transcriptional regulation during erythropoiesis [22].

The presence of zinc deficiency was higher in pregnant women with IDA. It was found that there was a statistical significant difference for zinc level concentration between pregnant women with IDA and control.

Conclusion:-

Zinc deficiency is more prevalence in anaemic pregnant women, and it's positively related to Hb and iron concentrations.

References:-

[1]- Soundarya, N. and Suganthi, P. (2016). A review on anaemia – types, causes, symptoms and their treatments. *Journal of science and technology investigation.* 1 (1): 10 -17.

[2]- Monarrez-Espino, J. Martinez, H. and Greiner, T. (2001). Iron deficiency anemia in Tarahumara women of reproductive-age in Northern Mexico. *Salud Publica Mex.* 43(5): 392-401.

[3]- El-Kholey, G. A. El-Berry, S. A. A. Sadek, A. M. Mansour, A. I. and El-Sayed, A. M. (2016). Iron deficiency anaemia during pregnancy in Qualiobeya. *International Journal of Advanced Research.* 4(6): 1955-1962.

[4]- Rasool, S. O. Zaman, B. A. and Abdulah, D. M. (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 Journal of Babylon.* 17(1): 103 – 108.

[5]- Breymann, C. (2013). Iron deficiency anemia in pregnancy. *Obstet. Gynecol.* 8(6): 587–596.

[6]- Salimi, S. Yaghmaei, M. Joshaghani, HR. and Mansourian, AR. (2004). Study of Zinc Deficiency in Pregnant Women. *Iranian J Publ Health.* 33(3): 15 – 18.

[7]- Kelkitli, E. Ozturk, N. Aslan, N. A. Kilic-Baygutalp, N. Bayraktutan, Z. Kurt, N. Bakan, N. and Bakan, E. (2016). Serum zinc levels in patients with iron deficiency anemia and its association with symptoms of iron deficiency anemia. *Annals of Hematology*. 95(5): 751 – 756.

[8]- Thinkhamrop, J. Apiwantanakul, S. Lumbiganon, P. Buppasiri, P. (2003). Iron status in anemic pregnant women. *J Obstet Gynaecol Res*. 29: 160 – 163

[9]- World Health Organization. Iron deficiency anaemia assessment prevention and control: a guide for programme managers, Vol. 132. Geneva: World Health Organization, (2001) (WHO/ NHD/01.3).

[10]- ACOG Practice Bulletin. (2008). Anemia in pregnancy. *Obstet Gynecol*. 95: 112 - 201.

[11]- Organization, W.H., Serum transferrin receptor levels for the assessment of iron status and iron deficiency in populations. (2014). World Health Organization.

[12]- Adam, I. Ibrahim, Y. and Elhardello, O. (2008). Prevalence, types and determinants of anemia among pregnant women in Sudan: a systematic review and meta-analysis. *BMC hematology*. 18(1): 1–8.

[13]- Fallatah, A.M. Bifari, A.E. Alshehri, H.Z. Wali, S.M. Alghamdi, S.A. Almusallam, S.A. AlAbbadi, W.S. and Albasri, S. (2020). Anemia and CostEffectiveness of Complete Blood Count Testing Among Pregnant Women at King Abdulaziz University Hospital: A Single Tertiary Center Experience. *Cureus.* 12(9).

[14]- Kassa G.M. (2017). Prevalence and determinants of anemia among pregnant women in Ethiopia; a systematic review and meta-analysis. *BMC hematology.* 17(1): p. 17.

[15]- Obai, G. Odongo P. and Wanyama, R. (2016). Prevalence of anaemia and associated risk factors among pregnant women attending antenatal care in Gulu and Hoima Regional Hospitals in Uganda: A cross sectional study. *BMC pregnancy and childbirth*. 16(1): p. 76.

[16]- A-Elbasit, E. M. Ali, A. and Mohammed, Ahmed, A. (2021). Estimation of Hemoglobin Levels in Pregnant and Non-pregnant Women in Rafha city, Saudi Arabia

[17]- Gupta, P. M. Hamner, H. C. Suchdev, P. S. Flores-Ayala, R. and Mei, Z. (2017). Iron status of toddlers, nonpregnant females, and pregnant females in the United States. *The American journal of clinical nutrition*. 106(6): 1640S-1646S.

[18]- Önal, S. Nazıroğlu, M. Çolak, M. Bulut, V. and Flores-Arce, M. F. (2011). Effects of different medical treatments on serum copper, selenium and zinc levels in patients with rheumatoid arthritis. *Biol Trace Elem Res.* 142:447- 455.

[19]- Soliman, J. S. A. and Amer, A. Y. (2019). Association of zinc deficiency with iron deficiency anemia and its symptoms: results from a case-control study. *Cureus*. 11(1).

[20]- Durrani, A. M. and Parveen, H. (2022). Zinc Deficiency and Its Consequences During Pregnancy. Microbial Biofertilizers and Micronutrient Availability, 69-82

[21]- Khoushabi, F. Shadan, M. R. Miri, A. and Sharifi-Rad, J. (2016).Determination of maternal serum zinc, iron, calcium and magnesium during pregnancy in pregnant women and umbilical cord blood and their association with outcome of pregnancy. Materia socio-medica. 28(2): 104.

[22]- Abdelhaleim, A. F. Amer, A. Y. and Abdo Soliman, J. S. (2019). Association of Zinc Deficiency with Iron Deficiency Anemia and its Symptoms: Results from a Case-control Study. Cureus. 11(1): 1 – 7.