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Association of Age, Parity and Body mass Index with Hemoglobin and Serum Ferritin Levels in Pregnant Women in Baghdad City

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Abstract

Hemogloin (Hb) and serum ferritin levels are used to assess anemia in pregnancy. Some studies referred to the influence of maternal age, body mass index (BMI) and parity on Hb and serum ferritin levels. The study aimed to examine the possible association of maternal Hb and serum ferritin with maternal age, parity, and BMI in a sample of pregnant women in Baghdad.

Ninety healthy pregnant women, grouped in three equal groups according to the pregnancy trimester, and thirty apparently healthy non-pregnant women from Baghdad were enrolled in this observational study. Blood and serum samples were obtained for the estimation of Hb and serum ferritin levels.

The pooled data of participants showed a negative correlation between parity and each of blood Hb concentrations (r= -0.147, P=0.046) and plasma ferritin levels (r= -0.186, P= 0.038). The negative correlation of parity with blood Hb concentration was reported in participants in the third trimester of pregnancy (r= -0.270, P=0.048); and between parity and plasma ferritin levels in the second (r= -0.088, P= 0.046) and third (r= -0.398, P=0.029) trimester pregnant. The study did not report a significant correlation between age and BMI with blood Hb concentrations or serum ferritin levels in pregnant women at any trimester of pregnancy.

There is a negative correlation between parity and each of blood Hb concentration and serum ferritin levels in pregnant women in Baghdad. While, there is no such correlation with maternal age and BMI at any trimester of pregnancy.

Keywords: Anemia, Hemoglobin, Ferritin, Parity, Pregnancy

ارتباط العمر وعدد مرات الانجاب ومؤشر كتلة الجسم مع مستويات الهيموغلوبين والفيريتين في المصل لدى النساء الحوامل في مدينة بغداد

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الخلاصة

يستخدم الهيموغلوين ومستويات الفيريتين في الدم لتقييم فقر الدم أثناء الحمل. أشارت بعض الدراسات إلى تأثير عمر الأم ومؤشر كتلة الجسم وعدد مرات الانجاب على مستويات الهيموغلوبين والفيريتين في الدم. هدفت الدراسة إلى فحص الارتباط المحتمل بين مستويات الهيموجلوبين والفيريتين للمرأة الحامل مع العمر وعدد مرات الانجاب ومؤشر كتلة الجسم في عينة من النساء الحوامل في مدينة بغداد.

المشاركين والطرق: تم تسجيل تسعين امرأة حامل يتمتعن بصحة جيدة، وتم تقسيمهن الى ثلاث مجموعات متساوية وفقًا لثلث الحمل؛ اضافة الى ثلاثين امرأة غير حامل من بغداد في هذه الدراسة القائمة على الملاحظة. تم الحصول على عينات الدم والمصل لتحديد نسب الهيموجلوبين والفيريتين.

أظهرت البيانات المجمعة للمشاركين وجود علاقة عكسية بين عدد مرات الانجاب و كل من تراكيز الهيموغلوبين في الدم (r= -0.147, P=0.046) ومستويات الفيريتين في المصل(r= -0.186, P= 0.038).

الارتباط العكسي بين عدد مرات الانجاب وتركيز الهيموغلوبين في الدم تم ملاحظته لدى الحوامل اللواتي كن في الثلث الثالث من الحمل- (r= 0.270, P=0.048) ; وبين عدد مرات الانجاب وفيريتين المصل في الحوامل اللواتي كن في الثلث الثاني(r= -0.088, P= 0.046) والثالث (r= -0.398, P=0.029) من الحمل.

لم تسجل الدراسة وجود علاقة معنوية بين العمر او مؤشر كتلة الجسم مع تركيز الهيموغلوبين أو الفيريتين لدى النساء الحوامل في أي ثلث من الحمل .

توجد علاقة ارتباطية عكسية بين عدد مرات الانجاب وكل من مستويات الهيموغلوبين و الفيريتين لدى النساء الحوامل في بغداد. بينما ، لا يوجد مثل هذا الارتباط مع عمر الأم ومؤشر كتلة الجسم في أي ثلث من الحمل

الكلمات المفتاحية : فقر الدم ، الهيموغلوبين ، الفيريتين ، عدد مرات الانجاب ، الحمل.

Introduction

Globally, anemia during pregnancy represents one of the most prevalent public health problems, causing negative maternal and fetal health effects [(1)] .The World Health Organization (WHO) defines anemia in pregnancy as the condition where hemoglobin (Hb) concentration is less than 11g/dL, at any trimester of pregnancy [(2)] .

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While, according to the Centers for Disease Control and Prevention guidance, anemia in pregnancy is when Hb concentration less than 11 g/dL at the first trimester and less than 10.5 g/dL in the second or third trimesters [3] .

It is estimated that 56% of pregnant women in low and middle-income countries and more than 10% in high-income countries have anemia. [1] Iron deficiency is the primary cause of anemia in about 75% of all anemia cases during pregnancy.[4] Other causes that are prevalent in developing countries involve micronutrient insufficiencies such as folic acid, vitamin A and vitamin B_{12}; some parasitic infections including malaria and hookworm; and chronic infections like tuberculosis and acquired immunodeficiency syndrome [5-7] .

In pregnancy, without supplementary iron, Hb concentration declines due to physiological hemodilution. Serum ferritin is sensitive indicator of body iron stores, and it is considered as a reliable indicator of iron status in pregnant women. [8] At the beginning of pregnancy, serum ferritin concentrations vary more widely than corresponding Hb values [9].

Some studies referred to the influence of maternal age, body mass index (BMI) and parity on Hb and ferritin levels [10-12].

The aim of the present work is to study the possible association of maternal Hb and serum ferritin with maternal age, parity, and BMI in a sample of Iraqi pregnant women.

Subjects and Methods

A cross-sectional study conducted at the Antenatal clinic in Baghdad Teaching Hospital in Baghdad city, the capital of Iraq, during the period extending from May to July 2019.

Ninety pregnant women, aged 18-45 years, were divided into three equal groups according to the trimester of pregnancy; and 30 apparently healthy non-pregnant married women to serve as control group, were enrolled in the study. Participants with history of diseases or treatments that interfere with blood Hb concentrations or serum ferritin levels were excluded from the study. Data regarding participants' age, BMI (calculated as weight in kilograms (kg) divided by height in meters squared (m^2)) and parity, are collected and recorded using a data collection sheet designed for the purpose of the study.

Five ml blood samples were collected, 2 ml in EDTA tube for estimation of Hb and 3 ml in plain tube for serum separation. The collected anticoagulated blood samples were used for Hb concentrations measurement using an automated hematology analyzer. While, serum samples were stored at -20°C until the time of estimation of ferritin levels by enzyme-linked immuno-sorbent assay (ELISA) test.

Ethical considerations

The ethics committee of the College of Pharmacy, University of Baghdad approved the study. Informed consent was obtained from each participant before participation in the study.

Statistical analysis

Statistical analysis was performed using SPSS® software version 22 for windows. Data are presented mainly as mean values and standard deviation (SD) or frequencies and percentages. Shapiro Wilk test was used to check the distribution normality for the dependent variables, blood Hb concentrations and serum ferritin levels. Mann-Whitney U test was conducted to examine differences between means of two groups, while Kruskal-Wallis H test was used to compare means among three or more groups. The Pearson's correlation coefficient (r) was used to evaluate the association between variables. A P value < 0.05 was considered statistically significant.

Results

The present study showed a significant differences between the means of blood Hb concentration and plasma ferritin levels of the pregnant and non-pregnant participants (P= 0.001 and P= 0.033; respectively). Meanwhile there is no significant difference between the means of age, BMI and parity of the pregnant and non-pregnant participants (P≥0.05) (Table 1).

Table 1. Participants' characteristics

Variable	Non-pregnant participants N=30	Pregnant participants N=90	P-value
Age (Year)	24.53 ± 6.16	26.06 ± 6.08	0.122
BMI (kg/m^2)	23.02 ± 1.94	24.29 ± 1.97	0.050
Parity	2.10 ± 1.27	2.32 ± 1.61	0.113
0	3 (10)	13 (14.4)	
1	6 (20)	13 (14.4)	
2	12 (40)	29 (32.2)	
3	4 (13.3)	14 (15.6)	
≥4	5 (16.7)	21 (23.4)	
Hb (g/dL)	12.74 ± 1.64	10.84 ± 1.78	**0.001**
<11	4 (13.3)	47 (52.2)	
>11	26 (86.7)	43 (47.8)	
Ferritin (ng/mL)	54.81 ± 19.23	36.86 ± 14.76	**0.033**

Comparison of participants' characteristics by the trimester of pregnancy showed that there is significant differences among means of BMI (P< 0.001), blood Hb concentrations (P< 0.001) and serum ferritin levels (P=0.029) of the studied groups (Table 2). Pairwise comparisons revealed that BMI mean of the participants in the third trimester of pregnancy is significantly higher than that of the non-pregnant or the first trimester pregnant participants. While, the mean of blood Hb concentrations of the participants in the third trimester of pregnancy is significantly lower than that of the non-pregnant or the first trimester pregnant participants. Moreover the mean of blood Hb concentrations of the participants in the second trimester of pregnancy is significantly lower than that of the non-pregnant participants. Finally, mean serum ferritin levels of the participants in the third trimester of pregnancy is significantly lower than that of the non-pregnant participants.

Table 2.Participants' characteristics by the trimester of pregnancy

Variable	Study Groups				P-value
	Non-pregnant participants	1st trimester	2nd trimester	3rd trimester	
Age (Year)	24.53 ± 6.16	23.72 ± 5.42	26.91 ± 4.92	26.18 ± 6.14	0.480
BMI (kg/m^2)	23.02 ± 1.94	23.75 ± 1.88	24.06 ± 1.93	25.07 ± 1.90[a,b]	**<0.001**
Parity	2.10 ± 1.27	2.70 ± 1.66	2.3 ± 1.47	1.93 ± 1.64	0.287
Hb (g/dL)	12.74 ± 1.64	11.60 ± 1.78	10.87 ± 1.74[a]	10.06 ± 1.52[a,b]	**<0.001**
Ferritin (ng/mL)	54.81 ± 19.76	47.88 ± 14.41	34.99 ± 16.86	27.71 ± 10.84[a]	**0.029**

[a] significant difference from the non-pregnant participants
[b] significant difference from participants in the first trimester of pregnancy

Correlation tests of the pooled data of pregnant participants of age, parity and BMI with blood Hb concentrations and serum ferritin levels, showed that there is a negative correlation between parity and each of blood Hb concentrations (r= -0.147, P=0.046) and plasma ferritin levels (r= -0.186, P= 0.038). Other correlation pairs testing did not show a significant correlation (P>0.05) (Table 3).

Correlation tests of age, parity and BMI with blood Hb concentrations and serum ferritin levels of the study groups showed that there is a negative correlation between parity and blood Hb concentrations in the third trimester pregnant (r= -0.270, P=0.048); and between parity and plasma ferritin levels in the second (r= -0.088, P= 0.046) and third (r= -0.398, P=0.029) trimester pregnant. Other correlation pairs testing among the study groups did not show a significant correlation (P>0.05) (Table 4).

Table 3. Correlation tests of age, parity and BMI with blood Hb concentrations and serum ferritin levels of the pregnant participants .

Correlated variables	r	P-value
Age vs. Hb	0.195	0.062
Age vs. Ferritin	0.079	0.459
BMI vs. Hb	0.134	0.198
BMI vs. Ferritin	0.175	0.100
Parity vs. Hb	-0.147	**0.046**
Parity vs. Ferritin	-0.186	**0.038**

Table 4. Correlation tests of age, parity and BMI with blood Hb concentrations and serum ferritin levels of the study groups.

Correlated variables	Control		1st trimester		2nd trimester		3rd trimester	
	r	P-value	r	P-value	r	P-value	r	P-value
Age vs. Hb	0.065	0.735	0.045	0.815	0.382	0.104	0.310	0.095
Age vs. Ferritin	0.006	0.974	0.034	0.860	0.015	0.938	0.219	0.245
BMI vs. Hb	0.286	0.125	0.275	0.141	0.077	0.685	0.267	0.153
BMI vs. Ferritin	0.100	0.599	0.164	0.386	0.120	0.528	0.104	0.586
Parity vs. Hb	-0.271	0.074	-0.039	0.083	-0.051	0.079	-0.270	**0.048**
Parity vs. Ferritin	-0.039	0.084	-0.045	0.089	-0.088	**0.046**	-0.398	**0.029**

Discussion

The study showed that 52.2% (47 of 90) of the pregnant participants are anemic with mean Hb concentration less than 11 gm/dL. The prevalence of anemia in pregnant women in the present study is higher than that reported by a recent study conducted in Baghdad (33.8%) which was conducted on larger cohort (400 participants).[13] Yet, the prevalence of anemia in pregnant women in low and middle-income countries was reported to be

56%. [1] The present study also showed that serum ferritin levels in pregnant women showed a significantly lower value than that of the non-pregnant. Physiologic anemia occurring during a healthy pregnancy is attributed mainly to increase in the plasma volume without sufficient increase in red cells count. [14] In young adult women, the stored iron is roughly about one tenth of the iron incorporated in hemoglobin. [15, 16] During pregnancy, the red cell volume expands to about 24–31% of the non-pregnant levels; [17, 18] this expansion of red cell volume results in depletion of the iron stores in most of pregnant women and hence serum ferritin levels. [19] On the other hand, the present study showed that 13.3% (4 of 30) of the non-pregnant participants have mean Hb concentration less than 11 gm/dL. Using the cut-off point of Hb for diagnosis of anemia in non-pregnant women is 11.9 will escalate the percent of anemic non-pregnant participants to 23.3% (7 of 30). The prevalence of anemia in the non-pregnant group is high, but it is still slightly lower than that reported in Iraq as of 2016 (29.1%). [20] Hypervolemia and the increase in fetal weight may represent the main causes of the increase in BMI with the advancement in gestational age.

The results showed a negative correlation between parity and each of blood Hb concentration and serum ferritin levels, which suggests a reduction of iron store with increasing parity. The results of this study in this regard occur in accordance with many reports, [21, 22] and disagree with others that reported no association between high parity and anemia or low iron stores. [23-25] Moreover, some studies reported a reduction in risk of anemia with high parity. [26, 27] Increased risk of bleeding during pregnancy as well as during and after delivery may represent the link between anemia and low iron store and increasing parity. Several mechanisms were proposed to explain the increased risk of bleeding with increased parity; yet, none of these mechanisms have been proven.[28]

The study did not show any significant correlation between age and BMI with blood Hb concentrations or serum ferritin levels in pregnant women at any trimester of pregnancy. This result do not agree with the results of other studies. For example, Mocking *et al.* has reported a positive correlation between BMI in first trimester and blood Hb concentrations in Indonesian and Ghanaian women;[29] while, Ramussen *et al.* has reported a significant association of blood Hb concentrations during pregnancy with maternal age, and with body mass index; with no correlation with serum ferritin levels [11].

Conclusion

Anemia is very prevalent among pregnant women in Baghdad. There is a negative correlation between parity and each of blood Hb concentration and serum ferritin levels. While, there is no such correlation with maternal age and BMI at any trimester of pregnancy.

The present study has some limitations. First, the causality between the correlated variables cannot be determined because of the nature of cross-sectional study. Second, being a single center study on relatively small sample size, prevent the finding to be generalized on pregnant women in Baghdad. Multi-center and larger cohort study is recommended.

References

1. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet. 2013;382(9890):427-51.
2. World Health Organization. Iron deficiency anaemia: assessment, prevention and control: a guide for programme managers. 2001.
3. CDC. Recommendations to prevent and control iron deficiency in the United States. MMWR Recomm Rep. 1998;47:1–29.
4. Di Renzo GC, Spano F, Giardina I, Brillo E, Clerici G, Roura LC. Iron Deficiency Anemia in Pregnancy. Women's health. 2015;11(6):891-900.
5. Okube O, Waithira M, Odhiambo E, Sabina W, Fissehaye M. Prevalence and Factors Associated with Anaemia among Pregnant Women Attending Antenatal Clinic in the Second and Third Trimesters at Pumwani Maternity Hospital, Kenya. Open Journal of Obstetrics and Gynecology. 2016;06:16-27.
6. Tay SCK, Nani EA, Walana W. Parasitic infections and maternal anaemia among expectant mothers in the Dangme East District of Ghana. BMC research notes. 2017;10(1):3.
7. Brooker S, Hotez PJ, Bundy DAP. Hookworm-related anaemia among pregnant women: a systematic review. PLoS neglected tropical diseases. 2008;2(9):e291-e.
8. Byg KE, Milman N, Hansen S, Agger AO. Serum Ferritin is a Reliable, Non-invasive Test for Iron Status in Pregnancy: Comparison of Ferritin with Other Iron Status Markers in a Longitudinal Study on Healthy Pregnant Women; Erythropoiesis. Hematology (Amsterdam, Netherlands). 2000;5(4):319-25.
9. Eskeland B, Malterud K, Ulvik RJ, Hunskaar S. Iron supplementation in pregnancy: is less enough? A randomized, placebo controlled trial of low dose iron supplementation with and without heme iron. Acta obstetricia et gynecologica Scandinavica. 1997;76(9):822-8.
10. Robinson S, Godfrey K, Denne J, Cox V. The determinants of iron status in early pregnancy. The British journal of nutrition. 1998;79(3):249-55.

11. Rasmussen S, Bergsjø P, Jacobsen G, Haram K, S Bakketeig L. Hemoglobin and serum ferritin in pregnancy - Correlation with smoking and body mass index. European journal of obstetrics, gynecology, and reproductive biology. 2005;123:27-34.

12. Hinderaker SG, Olsen BE, Bergsjo P, Lie RT, Gasheka P, Kvale G. Anemia in pregnancy in the highlands of Tanzania. Acta obstetricia et gynecologica Scandinavica. 2001;80(1):18-26.

13. Abdul-Fatah BN, Murshid R, Ahmed TE. Assessment of iron deficiency anemia (IDA) and dietary pattern among pregnant women in Baghdad city, Iraq. Journal of Pharmaceutical Sciences and Research. 2018;10:2279-84.

14. Fisher AL, Nemeth E. Iron homeostasis during pregnancy. The American journal of clinical nutrition. 2017;106(Suppl 6):1567S-74S.

15. Kiss JE, Birch RJ, Steele WR, Wright DJ, Cable RG. Quantification of body iron and iron absorption in the REDS-II Donor Iron Status Evaluation (RISE) study. Transfusion. 2017;57(7):1656-64.

16. Cook JD, Flowers CH, Skikne BS. The quantitative assessment of body iron. Blood. 2003;101(9):3359-63.

17. Goodlin RC. Effects of chronic exercise on blood volume expansion and hematologic indices during pregnancy. Obstetrics and gynecology. 1994;83(5 Pt 1):802.

18. Taylor DJ, Lind T. Red cell mass during and after normal pregnancy. BJOG: An International Journal of Obstetrics & Gynaecology. 1979;86(5):364-70.

19. Breymann C. Iron deficiency Anemia in pregnancy. Seminars in Hematology. 2015;52:339–47.

20. World Health Organization. Global Health Observatory Data Repository/World Health Statistics: http://apps.who.int/gho/data/node.main.1?lang=en (last accessed on Jan, 2020)

21. Rizk D, Khalfan M, Ezimokhai M. Obstetric outcome in grand multipara in the United Arab Emirates. A case control study. Archives of gynecology and obstetrics. 2001;264:194-8.

22. Kumari AS, Badrinath P. Extreme grandmultiparity: is it an obstetric risk factor? European Journal of Obstetrics & Gynecology and Reproductive Biology. 2002;101(1):22-5.

23. Toohey JS, Keegan KA, Jr., Morgan MA, Francis J, Task S, deVeciana M. The "dangerous multipara" : Fact or fiction? American Journal of Obstetrics & Gynecology. 1995;172(2):683-6.

24. Eugene M, Abedinego O. Grandmultiparity: Is it really an independent predictor of adverse pregnancy outcomes? Saudi Journal for Health Sciences. 2017;6(2):77-82.

25. Humphrey M. Is grand multiparity an independent predictor of pregnancy risk? A retrospective observational study. The Medical journal of Australia. 2003;179:294-6.

26. King PA, Duthie SJ, Ma HK. Grand multiparity: A reappraisal of the risks. International Journal of Gynecology & Obstetrics. 1991;36(1):13-6.

27. Silva LJP. Grand grand multiparity. Journal of Obstetrics and Gynaecology. 1992;12(5):301-3.

28. Aliyu M, Jolly P, Ehiri J. High Parity and Adverse Birth Outcomes: Exploring the Maze. Birth (Berkeley, Calif). 2005;32:45-59.

29. Mocking M, Savitri AI, Uiterwaal CSPM, Amelia D, Antwi E, Baharuddin M, et al. Does body mass index early in pregnancy influence the risk of maternal anaemia? An observational study in Indonesian and Ghanaian women. BMC Public Health. 2018;18(1):873.