Elite Journal of Haematology. Volume 2 issue 1(2024), Pp. 10-18
https://epjournals.com/journals/EJH

Assessment of the Serum Iron Status of Preeclampsia Subjects in Aba, Abia State

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Abstract

The present study assessed the levels of iron status and haemostatic parameters in preeclampsia subjects in Aba, Abia state Nigeria. A total of sixty subjects between the ages of eighteen to forty – four years were used for this study. Thirty were preeclampsia subjects who were medically diagnosed while thirty were apparently healthy individuals who served as control subjects. Serum iron and total iron binding capacity (TIBC) were determined. The results were analyzed using SPSS version 20.0. Probability value P<0.05 was considered statistically significant. The result showed that there was statistically higher mean ± SD of serum iron level in the preeclampsia subjects (76.93±8.09 ug/dL versus 65.20±6.43 ug/dL for control**)** and significantly lower Total Iron Binding Capacity in the preeclampsia subjects (284.97±16.01 ug/dL versus 295.50±18.53 ug/dL for control**)** when compared with the control. There were higher mean values of systolic blood pressure (154.83 ±10.54 mm/Hg versus 110.17 ± 12.35 mm/Hg for control), diastolic blood pressure (105.67±8.68 mm/Hg versus 70.50 ± 8.34 mm/Hg for control) in the preeclampsia subjects in comparison with their control values in this study. Higher than normal iron levels can increase the risk of low birth weight, preterm birth, and maternal high blood pressure.

Keywords: *Iron, Preeclampsia, fibrinogen, pregnancy, blood pressure*

Introduction

According to the American College of Obstetrics and Gynaecology[1], Preeclempsia is defined as the presence of hypertension and proteinuria occurring after 20 weeks of gestation in a previously normotensive subject. It is usually referred with subjects with elevated blood pressure of systolic ≥ 140 mmHg or diastolic ≥ 90 mmHg in not less than two (2) occasions, four hours apart. It is accompanied by proteinuria of ≥ 300 mg/24 hours and other features such as oedema.[2-9] Pre-eclempsia is a potentially dangerous pregnancy complication characterised by high blood pressure. Pre-eclampsia usually begins after 20 weeks of pregnancy in a woman whose blood pressure had been normal. It can lead to serious, even fatal, complications for both mother and baby.[10] There may be no symptoms. High blood pressure and protein in the urine are key features. There may

also be swelling in the legs and water retention, but this can be hard to distinguish from normal pregnancy.[11]

Iron is one of the most important micronutrients for human populations, given its central role in key biological processes. Iron is especially critical during pregnancy given the rapid cell and tissue development involved in fetal growth. Pregnancy has a net iron cost in the range of 600-800 mg.[12-26] The study was done to assess the levels of iron status in preeclampsia subjects in Aba, Abia state, Nigeria.

Materials and Methods

Study area

The study was done in Aba is a city in the southeast of Nigeria.

Advocacy Mobilization and Pre - survey Contacts

A formal letter of introduction was obtained from the Head of Department, Medical Laboratory Science of Imo State University, Owerri. The letter with the thesis proposal was submitted to the ethical committee of Abia State University Teaching Hospital, Aba. An ethical approval letter was obtained from the hospital to collect samples from the study participants. Questionnaires and informed consent were obtained from the subjects after several meeting on their clinic days. Also, a demographic data was obtained and a day was fixed for collection of blood samples.

Study Population

The sample size was calculated according to Aronye (2004). A total of sixty subjects between the ages of eighteen to forty – four years were used for this study. Thirty were preeclampsia subjects who were medically diagnosed while thirty were apparently healthy individuals who served as control subjects. The preeclampsia subjects were further grouped according to trimester, first trimester (n = 10), second trimester (n = 10) and third trimester (n = 10). Also, they were grouped according to age, 18 – 24, 25 – 34, 35 – 44 years.

Inclusion Criteria

The study participants were preeclampsia individuals who had been attending antenatal clinic at the Abia State University Teaching Hospital, Aba Nigeria for the past two to three months.
They were between the ages of 18 to 44 years. Subjects that were apparently healthy individuals served as control subjects.
Subjects agreed to be given informed written consent.

Exclusion Criteria

The study excluded:
Subjects below 18 years and above 44 years of age.
Subjects who have severe complications.
Individuals whom informed written consent were not obtained.

Blood Sample Collection

The blood samples were collected using standard venipuncture technique described by Kapil *et al*. (2017). Seven millilitress of blood was collected from each subject; 2.5 ml of blood was dispensed into 10% w/v dipotassium EDTA bottle for determination of platelets count while 3.6 ml of blood was dispensed into 0.4 ml of 3.8% of trisodium citrate container for the determination of serum

iron, total iron binding capacity, prothrombin time, platelet count, activated partial thromboplastin time and fibrinogen.[27]

Laboratory Procedures

All reagents were commercially purchased and the manufacturer's Standard Operating Procedures (SOP) were strictly followed.

Determination of Serum Iron

The test was done by spectrophotometric method according to Henry (1984) as modified by TECO Diagnostics, USA. Catalogue no; 1592

Procedure

Three test tubes were arranged in a test tube rack and labeled Test, Standard and Blank. Then, 2.5 mL of iron buffer reagent was added in all the tubes. In the tubes labeled; test, standard and blank, 500μL of serum, standard and distilled water was added to the corresponding tubes respectively. Lastly, 50μL of iron colour reagent was added to all the tubes. They were incubated for 10 minutes at temperature of 37^{o}C and the absorbance was read spectrophotometrically at a wavelength of 560nm against the reagent blank.

Calculation

$$\text{Serum Iron Concentration} = \frac{Absorbance\ of\ test}{Absorbance\ of\ std} \times 500$$

Normal range
60 - 150 ug/dL.

Determination of Unsaturated Iron Binding Capacity (UIBC)

The test was done by spectrophotometric method according to Henry (1984) as modified by TECO Diagnostics, USA. Catalogue number: 1592.

Procedure

Three test tubes were arranged in a test tube rack and labeled Test, Standard and Blank. In all the tubes, 2.0 mL of UIBC was added. In the tubes labeled test, standard and blank, 500μL of serum was added to the corresponding test, standard and blank tubes respectively. Then, 50μL of iron colour reagent was added in all the tubes. They were incubated for 10 minutes at temperature of 37^{o}C and the absorbance was read spectrophotometrically at a wavelength of 560nm against the reagent blank.

Calculation

$$\text{UIBC (ug/dL)} = \frac{Absorbance\ of\ test}{Absorbance\ of\ std} \times 500$$

TIBC - UIBC + Serum Iron

Normal range:
250 - 400 ug/dL.

Statistical Analysis

All statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 21. The results were expressed as mean and standard deviation in tables. Comparison of mean values among different groups was expressed using Student Independent T - test and one way analysis of variance (ANOVA). The probability at Level of $p < 0.05$ was considered statistically significant.

Results

Table 1: The Mean ± Standard Deviation of Blood Pressure in Preeclampsia Subjects of the Study Population

Parameters	Preeclampsia Subjects (n = 30)	Control Subjects (n = 30)	t - value	P - value
Systolic Blood Pressure (mm/Hg)	**154.83 ±10.54**	**110.17 ± 12.35**	**15.065**	**0.001***
Diastolic Blood pressure (mm/Hg)	**105.67 ± 8.68**	**70.50 ± 8.34**	**16.452**	**0.001***

Key:

n: Sample Size.

***: Significant level at P < 0.05.**

Table 1 shows the mean ± standard deviation of blood pressure in preeclampsia subjects of a study population. The result showed that the mean value (154.83± 10.54 **mm/Hg**) of systolic pressure in preeclampsia subjects was higher which was statistically significant (p = 0.001) when compared with the mean value (110.17± 12.35 **mm/Hg**) the control subjects.

Also, the mean value (105.67 ± 8.65 **mm/Hg**) of diastolic in preeclampsia subjects was higher which was statistically significant (P = 0.001) when compared with the mean value (70.50 ± 8.35 **mm/Hg**) of the control subjects.

Table 2: The Mean ± Standard Deviation of Iron Status in Preeclampsia Subjects of the Study Population

Parameters	Preeclampsia Subjects (n = 30)	Control Subjects (n = 30)	t – value	p - value
Serum Iron(ug/dL)	**76.93 ± 8.09**	**65.20 ± 6.43**	**1.844**	**0.037***
TIBC(ug/dL)	**284.97 ± 16.01**	**295.50 ± 18.53**	**2.356**	**0.022***

Key:

TIBC: Total Iron Binding Capacity;

n: Sample Size.

***: Statistically Significant at P < 0.05.**

Table 2. shows the mean ± standard deviation of iron status in preeclampsia subjects of the study population. The result showed that there was statistically significant (P = 0.037) higher mean value (76.93 ± 8.09 **ug/dL**) of serum iron in preeclampsia subjects when compared with the mean value (65.20 ± 6.43 **ug/dL**) of the control subjects. The mean value of (284.97 ± 8.09 **ug/dL**) of total

iron binding capacity in preeclampsia subjects was lower which was statistically significant (0.0022) when compared with the mean value (295.50 ± 8.53**ug/dL**) of the control subjects.

Table 4: The Mean ± Standard Deviation Values of Study subjects according to Trimester

Parameter	1st Trimester (n=10)	2nd Trimester (n=10)	3rd Trimester (n=10)	F-value	P-value
Serum Iron (ug/dL)	72.50 ± 10.25	73.10 ± 6.64	76.20 ±6..49	0.586	0.563
TIBC (ug/dL)	290.00 ±15.41	283.40 ± 12.29	281.50 ±19.83	0.764	0.476
Platelet Count($\times 10^9$/L)	269.40 ± 36.66	222.70 ± 11.93	213.40 ± 4.50	17.936	0.001*
PT (s)	12.70 ± 0.67	12.50 ±0.7	12.60 ± 0.97	0. 159	0.854
APTT (s)	27.30 ± 1.06	27.10 ±0.99	27.30 ± 1.25	0.109	0.897
Fibrinogen (mg/dL)	222.90 ± 24.17	225.50 ±14.32	225.00 ±11.47	0.062	0.940

Key:

N: sample size

TIBC: Total Iron Binding Capacity

APTT: Activated Partial Thromboplastin time;

PT: Prothrombin Time;

***: Statistically significant at P < 0.05.**

Table 4 shows the mean ± standard deviation of measured parameters in preeclampsia subjects according trimester. Results from Iron status showed that there was progressive increase in the mean values (72.50 ± 10.75 **ug/dL**, 73.10 ± 6.64, 76 **ug/dL** .20 ± 6.49 **ug/dL**) of serum iron in preeclampsia subjects trimester which was not statistically significant (P = 0.563) there was progressive decrease in the mean values (290.00 ± 15.41 **ug/dL**, 283.40 ± 12.29 **ug/dL**, 281.50 ± 19.83 **ug/dL**) of total iron binding capacity in preeclampsia subjects across all the trimester subjects which was not statistically significant (P = 0.476).

Table 5: The Mean ± Standard Deviation values of studied subjects in relation to age

Parameter	18 - 24 Years (n = 10)	25 - 34 Years (n = 10)	35 - 44 Years (n =10)	F-value	P-value
Serum Iron (ug/dL)	79.40 ±6.95	71.83 ±8.90	75.43 ±4.32	1.998	0.155
TIBC (ug/dL)	290.20 ±12.91	288.57± 17.17	282.11±16.49	0.716	0.498

Key:

N: Sample size

APTT: Activated Partial Thromboplastin time;

PT: Prothrombin Time;

***: Statistically significant at P < 0.05.**

Table 5. shows the mean ± standard deviation of measured parameters of preeclampsia subjects in relation age. The result from the iron status showed that there was non- progressive decrease in the mean values (76.40 ± 6.95 **ug/dL**, 71.83 ± 8.90 **ug/dL**, 75 ± 4.32 **ug/dL**) of serum iron in preeclampsia subjects across all ages which was not statistically significant (P = 0.155). There was progressive non statistically decrease (P = 0.498) in the mean values (290.20 ± 72.91 **ug/dL**, 288.57 ± 17.17 **ug/dL**, 282.11 ± 16.49 **ug/dL)** of total Iron binding capacity across all ages.

Discussion

Preeclampsia is a multisystem disorder of unknown etiology and is unique to pregnant women after twenty weeks of gestation. It is a progressive disease with a variable mode of presentation and rate of progression.[28]

The result from Table 1 showed higher levels of Systolic blood pressure and diastolic blood pressure in the preeclampsia subjects than the control, however, praclampsia is known to be associated with high blood pressure which may be due to not undergoing enough physical activity, being overweight, family history of pregnancy-related hypertension, alcohol intake, etc. These results were in accordance with the study carried out by Werdan *et al*.[29]

Table 2. gave higher Serum iron levels but lower Total iron binding capacity (TIBC) levels in the preeclampsia subjects when compared with the control subjects. The high serum iron levels may be due to hemolysis caused by physical destruction of red blood cells as a result of vasoapam and also due to decreased ability of transferrin to bind with free iron in the circulation, and is in accordance with the studies carried out by Poli *et al*.[30] and Zhu *et al*. [31]

The result from Table 4. showed **that the** values of total iron binding capacity decreased with increased pregnancy duration. Seo *et al*. [32] also reported similar results. This study agreed with the work carried out by Seo *et al*. [32] who had concluded that serum iron and fibrinogen levels are frequently abnormal in pregnancy.

In Table 5, the decrease in the total iron binding capacity as the ages of the preeclampsia subjects increases is in conformation with the study carried out by Linkins *et al*. [33] **while the variations in the serum iron** with regards to age reported in this study was similar to the work of Lu *et al*.[34]

Conclusion

In conclusion, a significant decline in platelets counts as well as an increase in serum iron and fibrinogen level in preeclampsia subjects was seen in this study. Higher than normal iron levels can increase the risk of low birth weight, preterm birth, and maternal high blood pressure.

References

1. American College of Obstetrics and Gynaecology Gestational hypertension and preeclampsia. *Obstetrics Gynaecology*. 2019; 133: 211–214.
2. Obeagu EI. Antioxidants and Pregnancy Complications: Exploring Therapeutic Strategies for Better Outcomes. Obstet Gynecol. 2024;7:001-6.

3. Emeka-Obi OR, Ibeh NC, Obeagu EI, Okorie HM. Studies of Some Haemostatic Variables in Preeclamptic Women in Owerri, Imo State, Nigeria. Journal of Pharmaceutical Research International. 2021 Aug 30;33(42B):39-48.
4. Obeagu EI, Obeagu GU, Obiezu J, Ezeonwumelu C, Alum EU, Ugwu OP. Antioxidants and Pregnancy: Impact on Maternal and Fetal Health. APPLIED SCIENCES (NIJBAS). 2023;4(1).
5. Emeka-Obi OR, Ibeh NC, Obeagu EI, Okorie HM. Evaluation of levels of some inflammatory cytokines in preeclamptic women in owerri. Journal of Pharmaceutical Research International. 2021 Aug 25;33(42A):53-65.
6. Obeagu EI, Ubosi NI, Uzoma G. Antioxidant Supplementation in Pregnancy: Effects on Maternal and Infant Health. Int. J. Adv. Multidiscip. Res. 2023;10(11):60-70.
7. Obeagu EI, Obeagu GU, Igwe MC, Alum EU, Ugwu OP. Neutrophil-Derived Inflammation and Pregnancy Outcomes. Newport International Journal Of Scientific And Experimental Sciences. 2023;4(2):10-9.
8. Obeagu EI, Obeagu GU, Ogunnaya FU. Deep vein thrombosis in pregnancy: A review of prevalence and risk factors. Int. J. Curr. Res. Chem. Pharm. Sci. 2023;10(8):14-21.
9. Obeagu EI, Gamade SM, Obeagu GU. The roles of Neutrophils in pregnancy. Int. J. Curr. Res. Med. Sci. 2023;9(5):31-5.
10. Li Z. *Arteriosclerosis, Thrombosis, and Vascular Biology*. 2010; 30(5): 2341–2349.
11. Kulkarni R. Alternative and Topical Approaches to Treating the Massicely Bleeding Patient. *Advances in Hematology*. 2004;**2** (7): 428–431.
12. Obeagu EI. Comparative Study of Serum Iron and Hemoglobin Levels of Cord Blood of Normal Neonates and that of Maternal Blood in Federal Medical Centre Owerri. Journal of Clinical and Laboratory Research. 2021;4(1):2768-0487.
13. Obeagu EI, Aneke J, Okafor CN, Essein UC, Ochei KC, Obeagu GU. Assessment of Serum Iron Status of Malnourished Infants in Umuahia, Abia State, Nigeria. Sch J App Med Sci. 2016;4:4384-7.
14. Obeagu EI, Eze VU, Alaeboh EA, Ochei KC. Determination of haematocrit level and iron profile study among persons living with HIV in Umuahia, Abia State, Nigeria. J BioInnovation. 2016;5:464-71.
15. Obeagu EI, Obeagu GU, Ukibe NR, Oyebadejo SA. Anemia, iron, and HIV: decoding the interconnected pathways: A review. Medicine. 2024 Jan 12;103(2):e36937.
16. Gamde MS, Obeagu EI. Iron Deficiency Anaemia: Enemical to Pregnancy. European Journal of Biomedical. 2023;10(9):272-5.
17. Obeagu EI, Oshim IO, Ochei KC, Obeagu GU. Iron and blood donation: A Review. Int. J. Curr. Res. Med. Sci. 2016;2(10):16-48.
18. Obeagu EI, Okeke EI, Anonde Andrew C. Evaluation of haemoglobin and iron profile study among persons living with HIV in Umuahia, Abia state, Nigeria. Int. J. Curr. Res. Biol. Med. 2016;1(2):1-5.
19. Obeagu EI, Amedu GO, Okoroiwu IL, Okafor CJ, Okun O, Ochiabuto OM, Ukeekwe CO. Evaluation of plasma levels of interleukin 6 and iron status of football players in a Nigerian university. Journal of Pharmaceutical Research International. 2021 Dec 18;33(59B):383-8.

20. Obeagu EI, Obeagu GU, Emeonye OP, Jakheng SP. An Upadte On Interleukin 6 And Iron Status Of Volleyball Players. Madonna University journal of Medicine and Health Sciences ISSN: 2814-3035. 2022 Jul 17;2(2):41-74.
21. Okamgba OC, Nwosu DC, Nwobodo EI, Agu GC, Ozims SJ, Obeagu EI, Ibanga IE, Obioma-Elemba IE, Ihekaire DE, Obasi CC, Amah HC. Iron Status of Pregnant and Post-Partum Women with Malaria Parasitaemia in Aba Abia State, Nigeria. Annals of Clinical and Laboratory Research. 2017;5(4):206.
22. Obeagu EI, Anierobi CC, Eze GC, Chukwueze CM, Makonyonga RD, Amadi NM, Hassan R. Evaluation of Plasma Levels of Interleukin 6 and Iron Status of Volleyball Players in a Nigerian University. Journal of Advances in Medical and Pharmaceutical Sciences. 2022 Jul 26;24(6):18-23.
23. Obeagu EI, Obeagu GU, Guevara ME, Okafor CJ, Bot YS, Eze GC, Amadi NM, Jakheng EW, Uwakwe OS. Evaluation of Plasma Levels of Interleukin 6 and Iron of Volleyball Players Based on Heights and Weight of a Nigerian University Students. Asian Journal of Medicine and Health. 2022 Aug 2;20(10):147-52.
24. Obeagu EI, Mohamod AH. An update on Iron deficiency anaemia among children with congenital heart disease. Int. J. Curr. Res. Chem. Pharm. Sci. 2023;10(4):45-8.
25. Obeagu E, Felix CE, MTB O, Chikodili UM, Nchekwubedi CS, Chinedum OK. Studies on some cytokines, CD4, iron status, hepcidin and some haematological parameters in pulmonary tuberculosis patients based on duration of treatment in Southeast, Nigeria. African Journal of Biological Sciences. 2021 Jan;3(1):146-56.
26. Okoroiwu IL, Chinedu-Madu JU, Obeagu EI, Vincent CC, Ochiabuto OM, Ibekwe AM, Amaechi CO, Agu CC, Anoh NV, Amadi NM. Evaluation of Iron Status, Haemoglobin and Protein Levels of Pregnant Women in Owerri Metropolis. Journal of Pharmaceutical Research International. 2021 Apr 29;33(27A):36-43.
27. Dong Z, Zheng J. Anticoagulation after coronary stenting: a systemic review. *British Medical Bulletin*. 2017; 123 (1): 79–89.
28. Diener H, Ntaios G, O'Donnell M, Easton JD. Non-vitamin-K oral anticoagulants (NOACs) for the prevention of secondary stroke. *Expert Opinion on Pharmacotherapy*. 2018; 19 (14): 1597–1602.
29. Werdan K, Braun-Dullaeus R, Presek P. Anticoagulation in atrial fibrillation: NOAC's the word. *Deutsches Arzteblatt International*. 2013; 110 (31): 523–524.
30. Poli D, Antonucci E, Pengo V, Migliaccio L, Testa S, Lodigiani C. Mechanical prosthetic heart valves: Quality of anticoagulation and thromboembolic risk. The observational multicenter PLECTRUM study. *International Journal of Cardiology*. 2018; 267(12): 68–73.
31. Zhu W, He W, Guo L, Wang X, Hong K. The HAS-BLED Score for Predicting Major Bleeding Risk in Anticoagulated Patients with Atrial Fibrillation: A Systematic Review and Meta-analysis. *Clinical Cardiology*. 2015; 38 (9): 555–561.
32. Seo Y, Andaya A, Leary JA. Preparation, separation, and conformational analysis of differentially sulfated heparin octasaccharide isomers using ion mobility mass spectrometry. *Analytical Chemistry*. 2012; 84 (5): 2416–2423.
33. Linkins LA, Hu G, Warkentin TE. *Research and Practice in Thrombosis and Haemostasis*. 2018; 2 (4): 678–683.

34. Lu J, Jian J, Huang W, Lin H, Li J, Zhou M. Experimental and theoretical identification of the Fe(VII) oxidation state in FeO^{4-}". Physical Chemistry Chemical Physics. 2016; 18 (45): 31125–31131.