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Assessment of correlation between iron profiles of pregnant women and their newborns

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Abstract
Introduction: IDA is the most frequent nutritional deficiency in pregnancy, with an impact on maternal and fetal morbidity and mortality. The objective of the present study was to determine the relationship between the iron status of pregnant women and their newborns using a combination of several hematological and biochemical parameters for the diagnosis of iron deficiency.
Method: Venous sample of 80 mothers and cord blood was taken in 2 vials- one in EDTA and the other in plain for CBC and serum haematological parameters respectively.
The following investigations of both the mother and the newborn were obtained and analysed.
1. Hemoglobin
2. Serum Ferritin
3. Serum Iron
4. Serum TIBC

Result and Conclusion: Median hemoglobin and ferritin concentrations were significantly lower in newborns Delivered from IDA mothers compared to non-anemic mothers. Additionally newborns Haemoglobin and ferritin concentration had a significant correlation with hemoglobin and ferritin concentration of the mothers.

Keywords: IDA iron deficiency anemia, CBC complete blood count, TIBC total iron binding capacity

Introduction
Anemia is the principal nutritional dearth in the world, and it especially affects children and pregnant women in developing countries. Nutritional Anemia according to the WHO, is a state in which the hemoglobin concentration in the blood is lower than levels considered normal for the age, gender, physiological state and altitude, as a consequence of shortage of essential nutrients, independent of the cause of this deficiency. Although nutritional anemia affects members of both sexes and all age groups, the problem is more prevalent among women and contributes to maternal morbidity and mortality, as well as to low birth weight. Pregnant women, owing to their high iron demand, are vulnerable to anemia, the prevalence of anemia is higher in pregnant women than in any other group in any given population. More than 50% of pregnant women are anemic, the majority of these anemic patients suffer from iron-deficiency anemia. Anemia is a condition in which the number of red blood cells or their oxygen carrying capacity is insufficient to meet physiologic needs, which may vary by age, sex, altitude, smoking and pregnancy status. Anemia in pregnancy is defined as a hemoglobin concentration below 11 g/dl by WHO. Amongst several causes of anemia in pregnancy, Iron Deficiency Anemia (IDA) is the most prevalent. It is one of the most prevalent nutritional deficiencies in the world, and more than half of the population in India is anemic. It is estimated by WHO that around 14% of the developed countries and 51% of the developing countries are affected with this condition. In India, around 65-75% are said to be affected. Ministry of Health and Family Welfare stated that iron deficiency anemia is a serious public health problem that affects the ability to study and work as well as health and well-being. Iron-deficiency anemia in pregnancy may have a serious effect on the health of both the mother and the baby; anemia can increase maternal and infant morbidity and mortality. The cause of iron-deficiency anemia in pregnancy is a complex combination of increased iron demand, low iron intake, and chronic blood loss. Many factors have been associated with the risk of iron-deficiency in pregnancy, eg nutritional status, socioeconomic variables, culture, age, educational status, parity, spacing of pregnancies, and the use of contraceptive devices. Maternal anemia leads to many adverse effects on the fetuses. Fetal complications such as low birth weight, preterm deliveries, developmental anomalies and neonatal death are some of them.

Prevention and management of maternal anemia is crucial to prevent morbidity and mortality of the fetus. There are four approaches towards prevention of anemia in pregnancy. These include dietary changes to increase the iron levels, iron supplementation, food fortification and other general public health measures. The difficulty in establishing a precise diagnosis of the iron status of pregnant women represent a complicating factor in the understanding of the relationship between maternal and fetal iron levels. The physiological changes that occurred during pregnancy (increased plasma volume and erythropoiesis) have a significant impact on hematological and biochemical parameters available for the assessment of iron status. Hemoglobin concentration is the most used parameter to detect anemia in public health care services due to its low cost and available reference standards. However, a combination of several parameters have been proposed in order to improve the diagnosis of iron deficiency. It is still not clear whether iron deficiency in pregnant women might lead to a deficient iron status of their children. Many studies have supported the belief that iron transport from the mother to their fetus occurs independently of maternal iron levels, and that it might even induce deficiency in the mother as a result of fetal "parasitism". However, later studies have questioned this belief and suggested that maternal iron deficiency can cause depletion of fetal iron stores. No consensus regarding this subject has been reached thus far. The objective of the present study was to determine the relationship between the iron status of pregnant women and their newborns using a combination of several hematological and biochemical parameters.

Material and Methods

A hospital based descriptive type of observational study was done on 80 singleton primi pregnant women at term gestation (37-42 weeks) admitted to labour room in Department of Obstetrics and Gynecology SMS Medical College and Hospital, Jaipur (Raj.) from November 2016 onwards.

Selection Criteria

Inclusion Criteria

- All singleton primi pregnant women at term gestation (37-42 weeks)
- All women who give consent to be a part of study. Exclusion Criteria
- Women with systemic disease such as hypertension, diabetes mellitus, heart disease and other chronic medical diseases.
- Women with congenitally malformed fetus or IUFD.

Method On admission in Labour Room, a detailed history was obtained regarding name, husband name, age, registration number and address. History of presenting complaints, menstrual history, period of amenorrhoea, obstetric history, past history, medical history and personal history especially diet was obtained. General physical examination was done meticulously to assess maternal conditions regarding anemia such as nutritional status, pallor, edema and glossitis. Systemic examination was done for respiratory and cardiovascular system. Obstetrical examination was done for fundal height and estimation of gestational age. Venous sample of the mother were taken in 2 vials- one in EDTA and the other in plain for CBC and serum haematological parameters respectively. Similarly cord blood was taken in 2 vials for above mentioned investigations. Routine antenatal investigations were done. The following investigations of both the mother and the newborn were obtained-Hemoglobin, Serum Ferritin, Serum Iron, Serum TIBC. Foetal and maternal outcome were compiled and statistical analysis done by entering the data from the analyzers and questionnaire into Microsoft Excel using SPSS version 16.0. Since all of the analytes studied were not normally distributed, nonparametric tests were applied. Frequencies, percentages, medians, and interquartile ranges (IQR) were computed to summarize the data. In order to compare quantitative and qualitative variables between the groups, Mann-Whitney and Chi-square tests were applied, respectively. Association of maternal and newborns parameters were assessed by spearman's correlation. *P*-value of <0.05 was considered as statistically significant in all analyses.

Results and Discussion

In our study, 50 mothers (62.5%) had hemoglobin concentration of >11 g/dl, 12 (15%) mothers had between 9.1-11g/dl, 10 (12.5%) has between 7.1-9g/dl and only 8 (10%) had <7g/dl hemoglobin concentration. The hemoglobin concentration in newborn was as follow as; 69 babies (86.25%) had 15.1-18 g/dl, 6 (7.5%) had 12.1-15g/dl, 4 (5%) had 9.1-12 g/dl and only 1 (1.25%) had <9g/dl hemoglobin concentration. The correlation between maternal and newborn hemoglobin was statistically significant in the newborn of mother with <7 gm/dl, 7.1-9 gm/dl & >11gm/dl hemoglobin (correlation coefficient and p-values was 0.14, 0.50, 0.61 and 0.0076**, 0.009** & 0.02** respectively).

64 mothers (80%) had serum ferritin of <50 ng/ml and 16 (20%) has serum ferritin between 50-200 ng/ml. The serum ferritin level in maximum newborns 51 (63.75%) was between 100-200ng/ml. Only 17 (21.25%) newborns had serum ferritin <100ng/ml and 12 (lk15%) newborn has >200ng/ml of serum ferritin. The newborn serum ferritin levels had significant correlation with ferritin levels of mothers. The mean ferritin levels in non-anemic and anemic mothers (taking 15ng/ml as cut-off) correlated well with the mean values of their newborns ($rr2$= 0.142, 0.253 respectively and *PP*-value was <0.001).

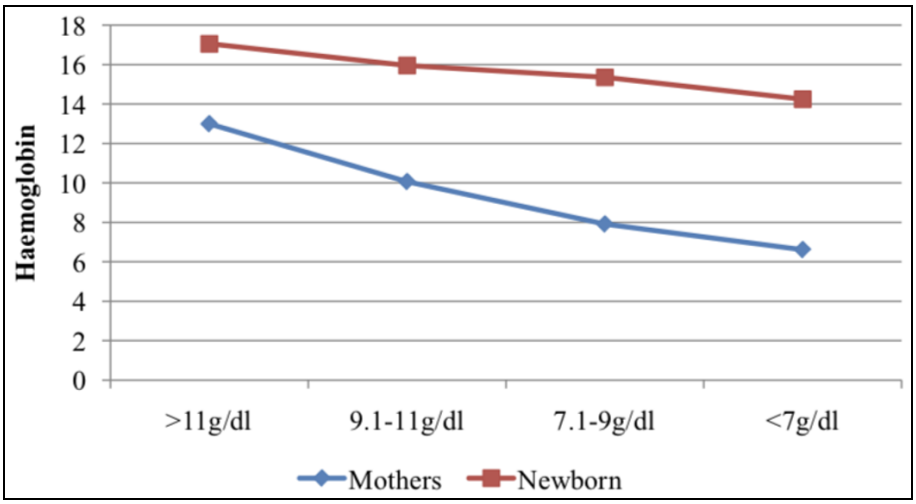
60 mothers (75%) had 0-100ng/ml of serum iron and 8 (10%) had >200ng/ml. The Serum iron levels of <150ng/ml were found in 8 (10%) newborns only and 48 newborns (60%) had Serum iron > 200ng/ml. The correlation between serum iron levels of the mother & newborns was not statistically significant. The mean values of serum iron in non-anemic and anemic mothers (taking 150ng/ml as cut-off) did not correlate well with the values in newborn ($rr2$ = 0.38, 0.50 respectively and *P*-values 0.056, 0.087 respectively).

52 cases (65%) has serum TIBC between 300-400 ng/ml and 4 cases (5%) had 400ng/ml of serum TIBC. The serum TIBC levels of 300-400ng/ml were found in 22 (27.5%) newborns and 9 cases (11.25%) had >400ng/ml and 4 cases (5%) had 100- 200 ng/ml of serum TIBC. The correlation between serum TIBC levels of the mother and newborns was not statistically significant. The mean values of serum TIBC in non-anemic and anemic mothers did not correlate with the values of the newborn (r2= -0.07, -0.06 and p-values of 0.2027, 0.36 respectively).

Table 1: Correlation of Hemoglobin Concentration in Mother with Newborn

Hb. Concentration	Mothers		Newborn	r2	p-value
	No.	Mean±SD	Mean±SD		
>11g/dl	50	12.99±1.483	17.05±1.087	0.6125	0.0217*
9.1-11g/dl	12	10.06±0.5299	15.95±2.185	0.3605	0.0664
7.1-9g/dl	10	7.910±0.6082	15.35±2.116	0.5088	0.0092**
<7g/dl	8	6.613±0.3182	14.24±1.689	0.1392	0.0076**

Table No. 1 shows the correlation of hemoglobin concentration in mother & newborn. Our study showed that the mean value of different level of hemoglobin concentration was higher in newborn as compared to mother's hemoglobin concentration. The spearman correlation of hemoglobin concentration was statistical significant in the newborns of mothers with hemoglobin concentration <7 gm/dl, 7.1-9g/dl and >11 g/dl (*rr* = 0.14, 0.50, 0.61 respectively and *PP* = 0.0076**, 0.009** & 0.02** respectively). With fall in the hemoglobin concentration in the mother, there is a statistical significant fall in the hemoglobin concentration in the newborn in all except 9-11 gm/dl group of the maternal cases.

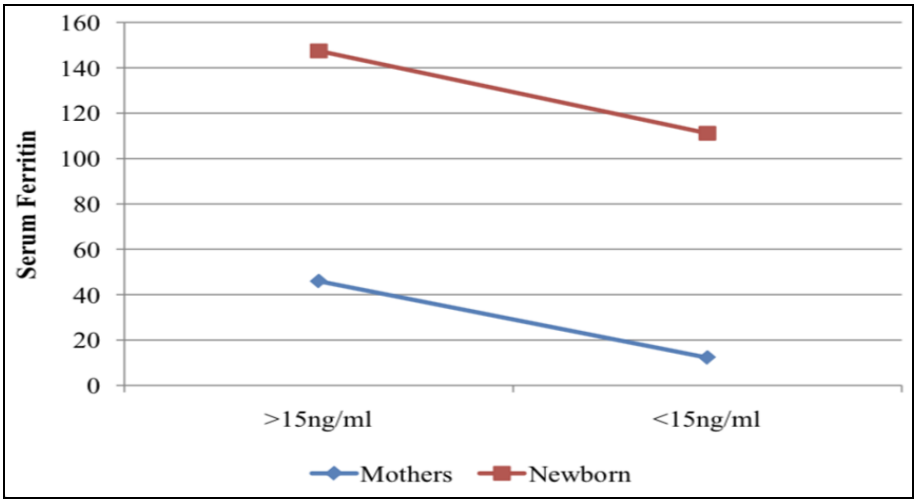


Graph 1: Correlation of Hemoglobin Concentration in Mother with Newborn

Table 2: Correlation of serum ferritin level in mother with newborn

Serum Ferritin	Mothers		Newborn	r2	P-value
	No.	Mean±SD	Mean±SD		
>15ng/ml	72	45.94±49.30	147.4±77.08	0.142	<0.001
<15ng/ml	8	12.25±3.174	111.1±52.46	0.253	<0.001

Table No. 2 show the correlation of serum ferritin level in mother with newborn. Our study showed that the cut-off point of maternal serum ferritin was <15 ng/dl. Accordingly, 8 mothers (10%) were grouped under anemic category while the rest 72 mothers (90%) were grouped under non-anemic category. The newborns ferritin level had significant correlation with hemoglobin (*rr*2= 0.142, *PP* <0.001) and ferritin (*rr*2= 0.253, *PP* < 0.001) levels of their mothers.

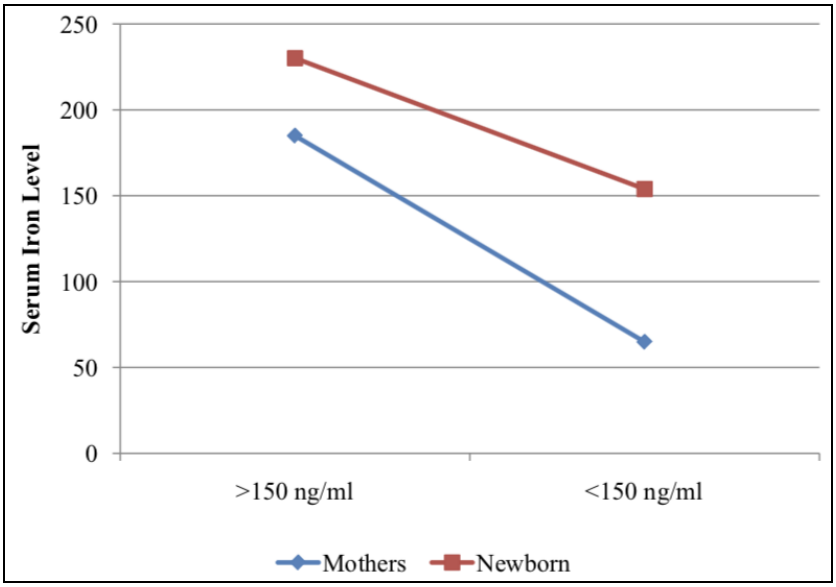


Graph 2: Correlation of serum ferritin level in mother with newborn

Table 3: Correlation of Serum Iron Level in Mother with Newborn

Serum Iron Level	Mothers		Newborn	r2	P-value
	No.	Mean±SD	Mean±SD		
>150 ng/ml	73	184.9±24.04	230.1±62.60	-0.47	0.0678
<150 ng/ml	7	64.86±24.21	153.9±29.32	-0.783	0.125

Table no. 3 shows the correlation of serum iron level in mother with newborn. The newborn's serum iron level does not correlate with ($rr2$= -0.47, PP=0.0678) ($rr2$= -0.783, PP = 0.125) iron levels of their mothers. It means, when serum iron concentration in mothers decreased, the iron concentration in newborn decreased, but the fall was not statistically significant.

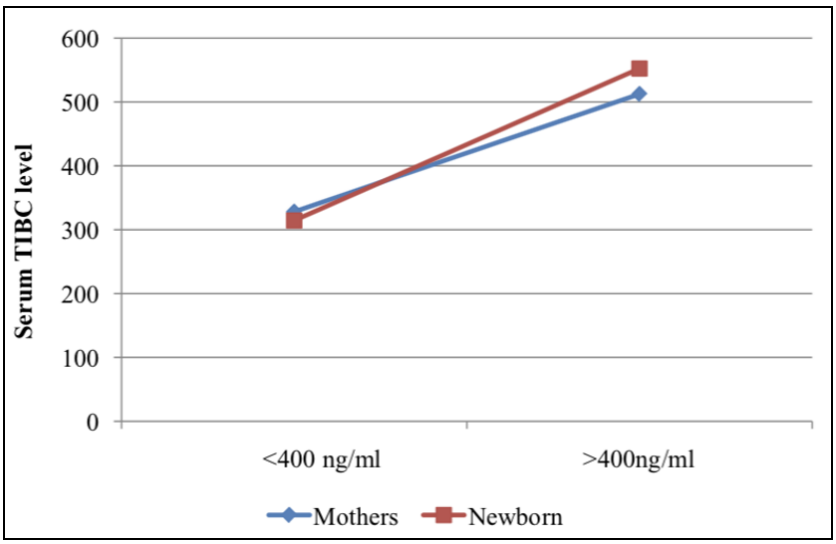


Graph 3: Correlation of Serum Iron Level in Mother with Newborn

Table 4: Correlation of Serum TIBC Level in Mother with Newborn

Serum TIBC level	Mothers	Newborn	r2	P-value
<400 ng/ml	328.1±48.32	314.4±80.06	-0.07	0.2027
>400ng/ml	512.5±62.92	552.5±50.58	-0.06	0.3599 NS

Table no. 4 shows correlation of serum TIBC level in mother with newborn. The newborns serum TIBC level does not correlate with TIBC (r2= -0.07, p=0.2027), (r2= -0.06, p = 0.36) levels of their mothers. It means, when serum TIBC concentration in mothers increased, the serum TIBC concentration in newborn also increased, but the rise was not statistically significant.



Graph 4: Correlation of Serum TIBC Level in Mother with Newborn

Conclusion

Anemia is a serious health problem in India where the lives of pregnant woman and her child are endangered. It is directly proportional to parity, less spacing between pregnancies and related to lower educational status. In spite of many researchers conducted on this issue, consistent findings were not evident. Some have reported the negative impact of maternal Iron deficiency anemia on iron stores of newborns, while others could not find any relationship in between. In our study, hemoglobin and ferritin concentrations were significantly lower in newborns delivered from anemic mothers compared to non anemic mothers. Additionally newborns hemoglobin and ferritin concentration had a significant correlation with hemoglobin and ferritin concentration of the mothers. Based on these findings, we can conclude that maternal anemia has a direct effect on the iron stores of newborns. Iron deficiency in pregnancy affects not only the mother but also the newborn. Hence correction of iron deficiency in mother, which can be achieved by regular antenatal check-up and iron supplements, is beneficial for improving the hemoglobin and iron stores of the new born and the overall maternal and fetal outcome.

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