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A STUDY ON IRON STATUS OF NEONATES BORN TO IRON DEFICIENT ANAEMIC MOTHERS

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Abstract

Background: Effective strategies are needed to control maternal anemia in the developing world. Improving the iron status of pregnant women by improving the nutrition as well as the regular intake of iron supplements will have a favorable impact on maternal, fetal and infant iron nutrition. Another approach to improve the iron status of the neonates is to delay the clamping of the cord after birth. The aim is to determine the relationship between the iron status of pregnant women and their newborn using a combination of hematologic and biochemical parameters for the diagnosis of iron deficiency. **Materials and Methods:** A hospital based cross-sectional study was conducted in the Department of Paediatrics, Shadan Institute of Medical Sciences, Teaching Hospital and Research center among 100 pregnant womens delivering singleton live births at term gestation (37-41 weeks). **Result:** In our present study, a positive correlation exists between the maternal and the neonatal hemoglobin levels. Even though the hemoglobin values of the babies falls in the normal range, their values show a correlation with the maternal hemoglobin levels. The RBC indices of the baby (MCV, MCH, MCHC), do not correlate with the maternal hemoglobin levels The serum iron and serum ferritin values of the neonates correlate with the maternal hemoglobin levels and serum ferritin are very low in the neonates of the mothers with severe iron -deficiency. **Conclusion:** In conclusion, the data of the present study indicate that maternal iron-deficiency adversely affects the cord blood iron status.

INTRODUCTION

Iron is a primary component of the body's the body's immune system. The risk of infection increases when iron deficiency anemia is present.[1] Pregnant women and children are at the highest risk for irondeficiency anemia and consequently impaired immunity.[2] Iron losses from menses can result in low iron stores in women of reproductive age and the iron needs of the growing fetus during pregnancy can increase these deficits.[3]

The sole source of neonatal iron during pregnancy is maternal iron. The placenta carries nutrients to the fetus. The role maternal iron plays in the development of neonatal iron stores remains inconclusive in existing literature.[4] Both high and low maternal iron states have been associated with adverse outcomes for the newborn. Serum ferritin >41ng/mL during the 3rdtrimester was associated with a preterm or very preterm delivery. Hemoglobin >130g/L in the first trimester posed a risk of low infant birth weight and preterm delivery.[5]

Iron is the most common micronutrient deficiency in the world. Anemia affects approximately 30% of the population, with the majority of cases being characterized as iron deficiency anemia. Approximately 18% of women in industrialized countries have iron deficiency anemia.[6] Children and pregnant women are at the highest risk for iron deficiency anemia. Iron losses from menses can result in low iron stores in women of reproductive age. The needs of the growing fetus during pregnancy can contribute to these deficits.[7]

Low birth weight, premature birth, exposure to lead, exclusive breastfeeding past 4 months of age without iron supplementation, and inadequate amounts of iron-fortifiedfoods after weaning, particularly to whole cows'milk increase the risk of iron deficiency anemia in children.[8] Iron deficiency anemia is a risk factor for poor cognitive and psychomotor development.[9]

The sole source of neonatal iron during pregnancy is maternal iron. Several studies have investigated the relationship between maternal and neonatal iron status. The placenta actsasthe nutrient transporter between the mother and fetus.[10] The placenta transfers iron to the fetus across the syncytiotrophoblast against a concentration gradient. In addition, investigated the possibility of this mechanism's ability torespond to iron deficiency in the fetus. Placental transferrin receptor increases in iron deficiency, and is associated with iron demands.

Aim

To determine the relationship between the iron status of pregnant women and their newborn using a combination of hematologic and biochemical parameters for the diagnosis of iron deficiency.

Objectives

To find whether iron deficiency anaemia in pregnant women may affect the iron reserves of their newborn and lead to anaemia in later life.

To find the correlation between haemoglobin and iron status of infant born to anaemic and non-anaemic mothers.

Find the correlation between haemoglobin, haematocrit, RBC indices, Serum iron and ferritin levels of the newborn with maternal levels.

MATERIALS AND METHODS

A hospital based cross-sectional study was conducted in the Department of Paediatrics, Shadan Institute of Medical Sciences, Teaching Hospital and Research center among 100 pregnant womens delivering singleton live births at term gestation (37-41 weeks).

Criteria for sample selection

Inclusion Criteria

- Pregnant women between ages 15-49 years.
- Those who are the resident in the study area.
- Those who are given consent to participate.

Exclusion Criteria

- Those who are taking iron supplementation.
- Those who are not interested to participate in this study.

Bivariate correlation between maternal and newborn haematological parameters.

Maternal: History of fever, Premature Rupture of Membranes, Foul Smelling Liquor, Antepartum Hemorrhage, PIH, Eclampsia, Liver disorders, Women with other systemic illnessor chronic medical conditions, Severe anaemia requiring blood transfusion.

Neonatal

Neonate needing NICU admission, Suspected chromosomal anomalies.

100 pregnant womens delivering singleton live births at term gestation (37-41 weeks)

GROUP-I: Infant born to anemic mother i.e. HB<ll g/dl

GROUP-2: Infant born to non-anemic mother i.e. HB>11 g/dl

The anthropometric measurements such as MUAC, height and weight were done by the help of MUAC tape for pregnant women, stadiometer and weighing machine respectively. The haemoglobin measurements of the participants were done by Cyanmethemoglobin method.

Blood sample of mother: collected prior to labour for complete blood count and iron profile.

Sample of neonate: Blood sample of neonate is taken from Cord Blood after birthfor complete blood count and iron profile.

Data Collection Techniques

a. Data collection for dependent variable Haemoglobin estimation was done by Cyanmethemoglobin method (WHO, 2001). Following are the procedures:
   i. 20 µl of whole blood was added to 5 ml of Drabkin's reagent.
   ii. After 10 minutes, absorbance (A) was measured against blank at 540 nm.
   iii. It was compared with the commercial standard and values were expressed as g¾.

RESULTS

Group-I: Infant born to anemic mother i.e. HB<ll g/dl

Group-2: Infant born to non-anemic mother i.e. HB>11 g/dl

Table 1: Classification of pregnant women into 4 groups according to the hemoglobin level

	Hemoglobin g/dl	n	Percentage
Group 1	HB<l l g/dl	63	63
Group 2	HB>l l g/dl	37	37
p-value		0.041	

In [Table 1], maximum number of pregnant women belongs to Group I (Hemoglobin <I I g/dl) (n=63) followed by Group 2 (>I I g/dl) (n=37). There is statistical Significant between both Groups.

Table 2: Education of the mothers in the four groups

Education of the Mother		Mother-Hemoglobin Category		p-value
		Group 1 HB<ll g/dl	Group 2 HB<ll g/dl	
Primary School	Count%	5	6	0.541
Middle School	Count%	8	9	0.612
High school	Count%	11	14	0.732
Higher Sec School	Count%	13	15	0.491
Degree	Count%	10	9	0.352

In [Table 2], Educational status of the mother of Higher Sec School was 13% in Group 1 and 15% in Group 2, followed by High schoolll % in Group 1 and 14% in Group 2, Degree 10% in Group 1 and 9% in Group 2.

Table 3: RBC indices of the mother

Mother hemoglobin category		HCT	MCV	MCH	MCHC
Group 1 HB<ll g/dl	Mean	25.260	77.985	21.061	26.770
	Std. Deviation	4.1485	10.4253	4.9985	4.5026
Group 2 HB<ll g/dl	Mean	31.562	85.985	28.999	31.785
	Std. Deviation	5.0526	9.2451	6.0485	4.0254
p-value		0.022	0.039	0.041	0.037

In [Table 3], RBC indices of the mother of mean HCT was 25.260 in Group I and 31.562 in Group 2. Mean MCV was 77.985in Group land 85.985in Group 2. Mean MCH was 21.061 in Group I and 28.999 in Group 2.Mean MCH was 26.770 in Group Iand 31.785 in Group 2. There is statistical Significant between both Groups.

Table 4: Iron and Ferritin Stores of the Mother

Mother hemoglobin category		ffiON	FERRITIN
Group 1 HB<ll g/dl	Mean	35.260	11.085
	Std. Deviation	6.1485	5.4253
Group 2 HB<ll g/dl	Mean	61.758	37.652
	Std. Deviation	28.9900	19.7125
p-value	0.041		

In [Table 4], mean Iron Stores of Mother hemoglobin in Group 1 was 35.260 and Group 2 was 61.758. Mean Ferritin Stores of Mother hemoglobin in Group 1 was 11.085 and Group 2 was 37.652. There is statistical Significant between both Groups.

Table 5: Anova table showing the RBC indices and iron stores of the mothers and its significance levels

			Mean Square	F	Sig.
HCT* mother HB category	Between Groups	(Combined)	360.985	56.989	.000
	Within Groups		8.450		
MCV* mother HB category	Between Groups	(Combined)	730.562	20.189	.000
	Within Groups		41.895		
MCH* Mother HB category	Between Groups	(Combined)	185.495	15.895	.000
	Within Groups		15.459		
MCHC* Mother HB category	Between Groups	(Combined)	37.956	15.506	.000
	Within Groups		4.669		
Iron* Mother HB category	Between Groups	(Combined)	4555.562	11.059	.000
	Within Groups		505.224		
Ferritin* Mother HB category	Between Groups	(Combined)	3580.059	30.592	.000
	Within Groups		126.789		

Table 6: RBC indices of the baby

Mother HB category		Baby HB	HCT	MCV	MCH	MCHC
Group 1 HB<ll g/dl	Mean	14.890	51.590	92.700	31.980	31.260
	Std. Deviation	3.1279	5.1616	6.8895	4.9985	.5689
Group 2 HB<ll g/dl	Mean	17.256	55.256	101.300	33.562	32.256
	Std. Deviation	3.256	8.2563	5.5623	.8562	3.256
p-value		0.413	0.742	0.819	0.571	0.477

In [Table 6], RBC indices of the Baby of Hb was 14.890 in Group 1 and 17.256 in Group 2. There is no statistical Significant between both Groups.

Mean HCT was 51.590 in Group 1 and 55.256 in Group 2. There is no statistical Significant between both Groups.
Mean MCH was 31.980 in Group 1 and 33.562 in Group 2.There is no statistical Significant between both Groups.
Mean MCH was 31.260 in Group 1 and 32.256 in Group 2. There is no statistical Significant between both Groups.

Table 7: Serum iron and Ferritin values of the baby

Mother HB Category		Iron	Ferritin
Group 1 HB<ll g/dl	Mean	126.256	54.200
	Std. Deviation	64.2562	15.256
Group 2 HB<ll g/dl	Mean	188.256	129.256
	Std. Deviation	63.2562	44.2563
p-value		0.031	0.025

In [Table 7], mean Serum iron of the baby 126.256 in Group 1 and 188.256 in Group 2.There is statistical Significant between both Groups.

Mean Serum Ferritin of the baby 54.200in Group 1 and 129.256 in Group 2. There is statistical Significant between both Groups.

Table 8: Correlations between the maternal and baby values and its significance

MOTHER HB CATEGORY		Mot HB	HCT	MCV	MCH	MCHC	Iron	Ferritin
Baby HB	Correlation	.351	.397	.299	.155	.099	.225	.178
	P.Value	.009	.005	.033	.312	.506	.099	.198
HCT	Correlation	.321	.360	.335	.185	.165	.185	.171

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	P.Value	0.15	.007	.009	.200	.235	.190	.208
MCV	Correlation	-.190	-.160	-.112	-.099	-.034	-.300	-.135
	P.Value	.165	.256	.452	.562	.952	.245	.1
415	Correlation	.315	.302	.444	.356	.256	.035	.033
	P.Value	.210	.211.002	.012	.325	.562	.952	
MCHC	Correlation	.056	.256	.256	.266	.065	.056	-.25
	P.Value	.852	.256	.253	.215	.785	.562	.999
Iron	Correlation	.310	.321	.314	.450	.219	.322	.214
	P.Value	.025	.062	.055	.005	.241	.065	.144
Ferritin	Correlation	.415**	.415**	.265	.265	.245*	.256*	.259
	P.Value	.015	.008	.565	.069	.055	.035	.65

Table 9: Hemoglobin levels in maternal and cord blood

Study group	Hemoglobin g/dl cord blood
Group 1	17.9
Group 2	19.2
p-value	0.031

In [Table 9], in Group 11 Hemoglobin g/dl cord blood (g/dl) l 7.9and Group 2 was 19.2. There is statistical Significant between both Groups.

Table 10: Serum Iron Levels in Maternal and Cord Blood

Study group	Serum iron mother Ug/dl	Serum iron new born ug/dl
Group 1	32.3	126.8
Group 2	78.7	169.5
p-value	0.023	0.518

In [Table 10], in Group 1 was Serum iron mother (Ug/dl)32.3, Group 2 was 78.7, Group 3 was 70.5 and Group 4 was 78.0. There is statistical Significant between both Groups.

In Group 1 was Serum iron new born(ug/dl) 126.8, Group 2 was 169.5, Group 3 was 182.6 and Group 4 was 188.9. There is no statistical Significant between both Groups.

Table 11: Serum ferritin levels in the maternal and the cord blood

Study group	Serum ferritin mother ng/ml	Serum ferritin cord blood ng/ml
Group 1	10.0	54.3
Group 2	48.7	129.7
p-value	0.023	0.518

In [Table 11], in Group 1 was Serum ferritin mother (ng/ml) l0.0 and Group 2 was 48.7. There is statistical Significant between both Groups.

In Group 1 was Serum ferritin cord blood (ng/ml) 54.3, Group 2 was 131.8, Group 3 was 133.5and Group 4 was 129.7. There is statistical Significant between both Groups.

Table 12: Maternal and neonatal RBC indices

	MCV		MCH		MCHC	
Groups	**Mother**	**Baby**	**Mother**	**Baby**	**Mother**	**Baby**
1	77.9	109	22	35.11	26.2	29.3
2	85.9	111.5	29.9	35.82	33.5	34.4

In [Table 12], in Group 1 MCV of mother was 77.9 and Baby was 109, in Group 2 MCV of mother was 85.9 and Baby was 111.5.

In Group 1 MCH of mother was 22 and Baby was 35.11, in Group 2 MCH of mother was 29.9 and Baby was 35.82.

In Group 1 MCHC of mother was 26.2 and Baby was 29.3, in Group 2 MCH of mother was 33.5 and Baby was 34.4.

DISCUSSION

Iron deficiency anemia is the most common nutritional deficiency disorder affecting the pregnant women in our country with a significant impact on maternal and fetal mortality and morbidity. In the present study, 100 pregnant women were selected based on the inclusion and exclusion criteria. Out of 100 women, 14 had hemoglobin values less than 11 with normal iron stores pointing towards other causes of anemia and they were not included in the study. The remaining 61 pregnant women were divided into 2 groups depending on their hemoglobin values according to the classification of anemia in pregnant women by Indian Council of Medical Research.

Pregnant women with severe anemia (hemoglobin <1lg/dl) (Hemoglobin <11 g/dl) (n=63) followed by Group 2 (>11 g/dl) (n=37). There is statistical Significant between both Groups.

In our study, in Group 1 Hemoglobin g/dl cord blood (g/dl) 17.9 and Group 2 was 19.2. There is statistical Significant between both Groups.

In our study, in Group 1 was Serum iron mother (Ug/dl)32.3, Group 2 was 78.7, Group 3 was 70.5 and Group 4 was 78.0. There is statistical Significant between both Groups.

In Group 1 was Serum iron cord blood (ug/dl) 126.8, Group 2 was 169.5, Group 3 was 182.6 and Group 4 was 188.9. There is no statistical Significant between both Groups. The values of hemoglobin, serum iron and serum ferritin in the cord blood were higher than the maternal blood. Similar results were obtained in the studies conducted by Kumar et al in India.[11]

RBC indices of the Baby ofHb was 14.890 in Group 1 and 17.256 in Group 2. There is no statistical Significant between both Groups.

In our study, Mean HCT was 51.590 in Group 1 and 55.256 in Group 2. There is no statistical Significant between both Groups. Mean MCV was 92.700 in Group land 101.300 in Group 2. There is no statistical Significant between both Groups. Mean MCH was 31.980 in Group 1 and 33.562 in Group 2. There is no statistical Significant between both Groups. Mean MCH was 31.260 in Group 1 and 32.256 in Group 2. There is no statistical Significant between both Groups. The mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration were higher in the cord blood compared to the maternal blood. Similar results were obtained in the studies done by Lao et al and K.V.Shyamala et al.[12]

In the study conducted by Shyamala et al, in Mangalore there was no significant difference in the neonatal hemoglobin levels between the case group (neonates of anemic mothers) and the control group (neonates of non-anemic mothers). But they divided the mothers into two groups (anemic and non-anemic). In another study conducted by Ziaei et al,[13] in Iran they have found a significant difference in the neonatal hemoglobin between the three groups. (anemic, iron-deficient, non-anemic and non-iron-deficient).

In the study, conducted by Kumar et al,[11] in Varanasi he took many women with severe anemia and he got a similar result.

Correlation between the neonatal RBC indices with the maternal hemoglobin levels. The mean value of MCV, MCH and MCHC in the neonates in all the four groups do not show any significant relationship with respect to the maternal hemoglobin levels.

Similarly, our study showed that children of less educated mothers consumed less meat, poultry (and their derivatives), fish, and shell fish but consumed more vegetables. The major cause of anemia may be a diet low in meat, fish, or poultry.[11,12] Heme iron from hemoglobin and myoglobin found in meat, fish, and poultry are effectively absorbed by receptors in the gut, whereas the bioavailability of non-heme iron from plants is low. Differences in food-group consumption were observed in this study in terms of the smaller quantities of food derived from animal sources that were consumed by children in the low-maternal-education group. These results explain why children of less educated mothers showed a higher prevalence of anemia.

Thus, a relationship between the educational level of mothers and the quality of the diet of their children has been observed. Children with less educated mothers consumed less of most vitamins and minerals and were less likely to have consumed a range of "health foods". It is possible that the food-consumption behavior of children may lead to both iron deficiency and obesity. Specific habits, such as snacking and eating junk food, may also contribute to anemia. People with higher levels of education have better eating habits and may therefore be healthier.

CONCLUSION

The birth weight of the babies does not correlate with the maternal hemoglobin levels. But comparing with the babies of the mothers with normal hemoglobin levels, the babies of the mothers with severe anemia show a low birth weight. The neonates of both anemic and non-anemic women may be born with a hemoglobin in the normal range but the iron stores of the neonate depend on the maternal iron status. The iron available for erythropoeisis is low in the babies of anemic mothers than non-anemic mothers. Whatever iron available for them is utilized to keep the hemoglobin in the normal range and not used for building up the iron stores. The low iron stores of the neonates may be depleted easily, when the demands are high in early infancy. Iron deficiency in early life may have long term adverse effects on the cognitive development and may also impair cellular immunity. Thus the deleterious effects of maternal anemia extend far beyond pregnancy and early infancy. Effective strategies are needed to control maternal anemia in the developing world. Improving the iron status of pregnant women by improving the nutrition as well as the regular intake of iron supplements will have a favorable impact on maternal, fetal and infant iron nutrition. Another approach to improve the iron status of the neonates is to delay the clamping of the cord after birth54. In conclusion, the data of the present study indicate that maternal iron-deficiency adversely affects the cord blood iron status.

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