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ASSOCIATION BETWEEN MATERNAL AND NEONATAL HEMOGLOBIN IN A TERTIARY CARE CENTRE OF KUMAON REGION IN UTTARAKHAND

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Abstract

Background - Iron Deficiency Anaemia (IDA) is one of the most frequently observed nutritional deficiency diseases in the world during pregnancy and it is often a contributory cause of maternal death. It can be specifically defined by the increase in hemoglobin concentration post iron therapy.
Aim-To study the association between maternal hemoglobin with neonatal hemoglobin in a tertiary care centre in Kumaon region of Uttarakhand.
Materials and Methods- This is a Prospective Observational Study conducted at Labor room and operation theatre of Dr. Susheela Tiwari Government Hospital, Haldwani, Uttarakhand from January 2020 to September 2021.
Results- There was a significant positive correlation between maternal hemoglobin and baby's hemoglobin (p value <0.001), baby retic count (p value <0.001), RBC , MCH (p value <0.001), MCV (p value <0.001) and MCHC (p value <0.001).

Introduction

Iron is one of the most important micronutrient in the body. It is involved in oxygen transport by synthesizing the oxygen transport proteins hemoglobin and myoglobin, and for production of the enzymes involved in oxidation-reduction and electron transfer.[1] Out of this, 50% of the iron stores are present in hemoglobin. Therefore, when a deficit of iron develops, it affects the production of erythrocytes - making anaemia a prominent characteristic of iron deficiency. [2]
According to the most recent WHO reports, the worldwide prevalence of anaemia in pregnant women is 36.5%. [3,4] It ranges from 51% in developing countries to 14% in developed countries and in India between 65 to 75%. [5,6] India has the highest prevalence of anaemia in pregnancy and is the home of largest number of anaemic pregnant women in the world. [7,8]
Several dietary factors may lead to this condition - it is found that many pregnant women make no significant changes to their diet during pregnancy, even though iron intake requirements increase exponentially. [9] Other factors leading to IDA include disturbed metabolism, multiple pregnancies, pre-pregnant health status, inflammation, or infectious diseases, and some epidemiological determinants include a low socioeconomic status, age below 18 or after 25, and level of education. [10]

The iron needs of a developing fetus are entirely dependent on the transport from maternal stores occurring through placental transferrin receptors. When maternal iron stores decrease, the production of these receptors is upregulated, thus helping absorb the required amount of iron nonetheless. This might explain why infants born to anaemic mothers usually have normal iron levels. [11] Severe

anaemia, however, can result in deleterious effects in the developing fetus, resulting in reduced neurocognitive development, increased risk of chronic disease, and mortality.[12] It is also associated with low birth weight and preterm labor. Interestingly, high Hb stores are harmful as well, and are associated with abnormal birth weight.[13,14,15,16] Evidence also indicates that these effects continue well into the first year of life.[11] Benefits of iron supplementation remain questionable during pregnancy, and it must be approached cautiously. Maternal anaemia is, thus, a major public health concern leading to impairments in developing children, but it is preventable and easily treatable with adequate and timely interventions.

This prospective observational study with a sample size of 300 examines this association in the Kumaon region in Uttarakhand, conducted in Department of Paediatrics, Government Medical College & affiliated to Dr Susheela Tiwari Govt. Hospital, Haldwani between January 2020 and September 2021. Pregnant mothers attending the labor room and operation theatre in Government Medical College Haldwani and their babies delivered were included in this study. These included babies born after 34 weeks of pregnancy with both normal vaginal deliveries as well as the deliveries by caesarian section, and both multiparous as well as primiparous women will be included. Only women with singleton pregnancies were considered. Newborns with congenital malformations, birth asphyxia, Rh incompatibility and pathological jaundice were excluded, and maternal risk factors like gestational diabetes mellitus, pregnancy induced hypertension, placenta previa and abruptio placenta were used as exclusion criteria as well.

AIMS AND OBJECTIVES

AIM:

To study the association between maternal hemoglobin with neonatal haemoglobin in a tertiary care centre in Kumaon region of Uttarakhand.

OBJECTIVES:

I. To correlate maternal anaemia with cord blood hemoglobin and its effect on birth weight of neonates.
II. To compare RBCs parameter and RBCs precursor in umbilical cord blood of neonate born to anaemic and non-anaemic mothers.

MATERIAL AND METHODS

STUDY DESIGN: Prospective Observational Study

PLACE OF STUDY: This study was conducted at Labor room and operation theatre of Dr. Susheela Tiwari Government Hospital, Haldwani, Uttarakhand.

STUDY PERIOD: January 2020 to September 2021

STUDY POPULATION: After obtaining approval from the Institutional Ethical Committee, the study included pregnant women and their newborns delivered at Dr. Susheela Tiwari Govt. Hospital, Haldwani, Uttarakhand.

Based on the maternal hemoglobin values mothers were classified into two groups:

Anaemic Group: mothers with hemoglobin values < 11g/dl

Non anaemic Group: mothers with hemoglobin >11g/dl

SAMPLE SIZE

For tests of association using bivariate correlations, a moderate correlation between maternal hemoglobin with neonatal hemoglobin will be considered meaningful. To detect a moderate correlation (r = 0.496), a sample of 39 analyzable subjects will provide 90% power to discover that the correlation is significantly different from there being no correlation (i.e. that the correlation would be zero) at the 0.05 level .

Formula used

$N = [(Z\alpha+Z\beta)/C]2 + 3$

Where
The standard normal deviate for $\alpha = Z\alpha = 1.96$
The standard normal deviate for $\beta = Z\beta = 1.282$

$C = 0.5 * \ln[(1+r)/(1-r)]$
$=0.5*\ln[1.496/0.504]$
$=0.5*1.088$
$=0.544$

$N=[(1.96+1.282)/0.309]\ 2 + 3$
$=[3.242/0.544]\ 2 + 3$
$= 35.51+3$
$= 38.52$

However, we would be taking minimum of 300 pregnant women and their newborns delivered during the study period.

RESULTS AND OBSERVATIONS

Table 1: Distribution of patients according to different socio demographic variables

Variables	Frequency	%
Gravida		
Primi	105	35.0%
2	103	34.3%
>=3	92	30.7%
POG		
<37 weeks	77	25.7%
37 - 39 weeks	202	67.3%
>=40 weeks	21	7.0%
Mode of Delivery		
LSCS	162	54.0%
NVD	138	46.0%
Maternal Hb		
Anaemic	183	61.0%
Non Anaemic	117	39.0%

Table 2- Baseline characteristics of Baby and Mother

	Mean ± SD	Min - Max	Median (IQR)
Birth Wt	2.513 ± 0.37	1.8 - 3.8	2.45 (2.26 - 2.70)
Maternal Hb	10.232 ± 1.47	6.9 - 14.3	10.50 (9.20 - 11.20)
Baby Hb	16.55 ± 2.12	8.5 - 20.7	16.80 (15.20 - 18.10)
Baby Retic count	2.82 ± 1.17	1 - 5	2.90 (1.90 - 3.80)
RBC	4.32 ± 1.02	2.0 - 6.9	4.23 (3.56 - 4.98)
MCH	30.05 ± 2.18	24.0 - 40.6	34.80 (33.50 - 35.20)
MCV	98.33 ± 5.55	63.0 - 111.9	99.50 (97.50 - 100.80)
MCHC	34.35 ± 1.27	30.2 - 39.8	34.60 (33.80 - 35.10)

Table 3: Comparison of gravida distribution between the two groups i.e. anaemic and non anaemic

Gravida	Maternal Hb				p value
	Anaemic		Non Anaemic		
	Frequency	%	Frequency	%	
Primi	62	33.9%	43	36.8%	0.111
2	57	31.1%	46	39.3%	
>=3	64	35.0%	28	23.9%	
Total	183	100%	117	100%	

Table 4- Comparison of period of gestation (POG) between the two groups i.e. Anaemic and Non anaemic

POG	Maternal Hb				p value
	Anaemic		Non Anaemic		
	Frequency	%	Frequency	%	
<37 weeks	52	28.4%	25	21.4%	0.115
37 - 39 weeks	122	66.7%	80	68.4%	
>=40 weeks	9	4.9%	12	10.3%	
Total	183	100%	117	100%	

Table 5: Comparison of distribution of patients according to mode of delivery between the two groups i.e. anaemic and non anaemic

MOD	Maternal Hb				p value
	Anaemic		Non Anaemic		
	Frequency	%	Frequency	%	
LSCS	97	53.0%	65	55.6%	0.666
MOD	86	47.0%	52	44.4%	
Total	183	100%	117	100%	

Table 6: Comparison of mean birth weight between Anaemic and Non Anaemic mothers

	Maternal Hb		p value
	Anaemic	Non Anaemic	
	Mean ± SD	Mean ± SD	
Birth Wt	2.41 ± 3.18	2.67 ± 3.89	<0.001**

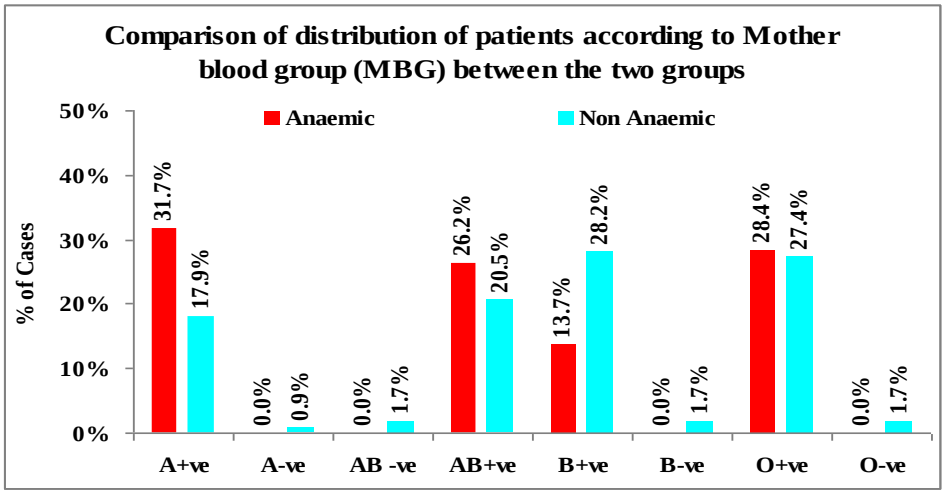

Figure1-

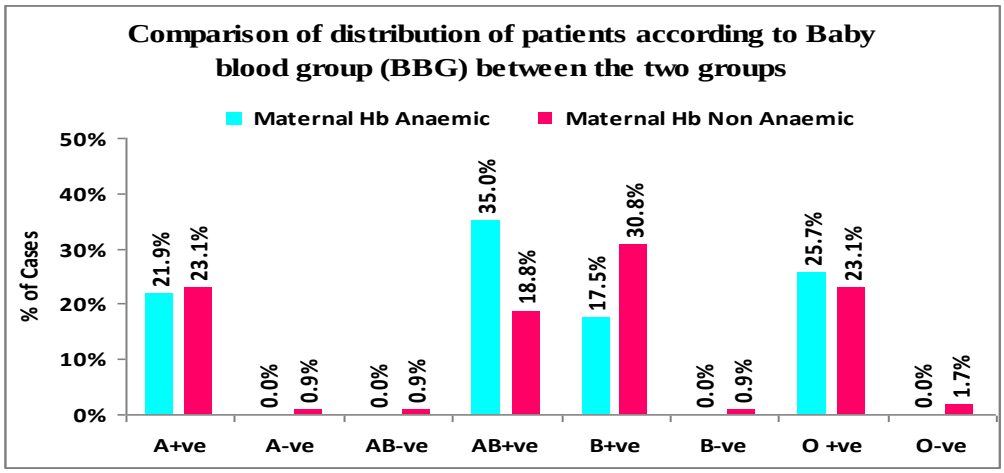

Figure 2

Table7: Comparison of various parameters between Anaemic and Non Anaemic mothers

	Maternal Hb		p value
	Anaemic	Non Anaemic	
	Mean ± SD	Mean ± SD	
RBC	3.93 ± 0.88	4.92 ± 0.93	<0.001**
MCH	33.73 ± 2.16	34.55 ± 2.14	0.001*
MCV	97.69 ± 4.80	99.35 ± 6.43	0.011*
MCHC	34.11 ± 1.20	34.73 ± 1.27	<0.001**

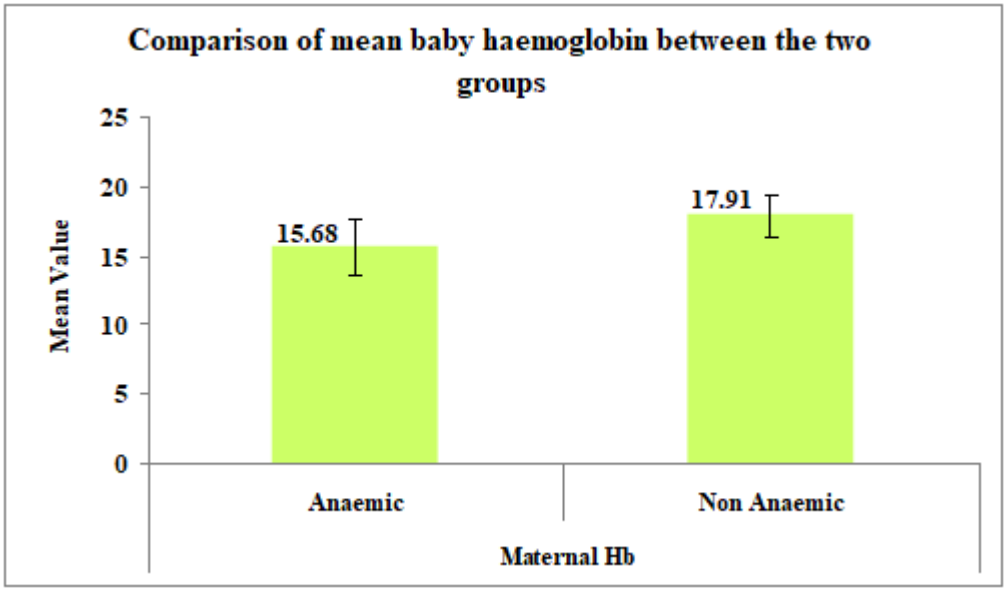

Figure 3

Table 8: Comparison of mean baby retic count between Anaemic and Non Anaemic mothers

	Maternal Hb						p value
	Anaemic			Non Anaemic			
	Mean ± SD	Min-Max	Median (IQR)	Mean ± SD	Min - Max	Median (IQR)	
Baby Retic count	2.43 ± 1.03	1 - 4	2.50 (1.7-3.2)	3.43 ± 1.12	1 - 5	3.70 (2.55-4.2)	<0.001**

The table 1 shows the distribution of patients according to gravida. It was observed that 35% of the patients had Primigravida while 34.3% had gravida of 2 and 30.7% of the patients had gravida of >=3. Distribution of patients according to POG. It was observed that 67.3% of the patients had POG of 37-39 weeks while 25.7% had POG of <37 weeks and 7.0% patients had POG of >=40 weeks. Distribution of patients according to Maternal hemoglobin. It was observed that 61% of the patients were anaemic while 39% were non anaemic. It was observed that 54% of the patients had LSCS mode of delivery while 46% had NVD as mode of delivery.

The table 2 shows the mean of various parameters for all the patients under the study. It was observed that mean birth weight of the patients was 2.513 ± 0.37 kg while mean maternal hemoglobin was 10.232 ± 1.47, mean baby hemoglobin was 16.55 ± 2.12, mean baby retic count was 2.82 ± 1.17, mean RBC was 4.32 ± 1.02, mean MCH was 30.05 ± 2.18, mean MCV was 98.33 ± 5.55 and mean MCHC was 34.35 ± 1.27.

The table 3 shows the comparison of distribution of patients according to gravida between the two groups i.e. anaemic and non anaemic under the study. It was observed that under the group anaemic, 35% of the patients had a gravida of >=3, 33.9 % had primigravida and 31.1% had gravida of 2. Under the group non anaemic, 23.9% of the patients had a gravida of >=3, 36.8 % had primigravida and 39.3% had gravida of 2. Further, it was observed that there was no significant difference in

distribution of patients according to gravida when compared between the two groups (p value 0.111). The table 4 shows the comparison of distribution of patients according to gestational age (POG) between the two groups i.e. anaemic and non anaemic under the study. It was observed that under the group anaemic, 66.7% of the patients had POG of 37-39 weeks, 28.4% had POG of <37 weeks and 4.9% had POG >=40 weeks. Under the group non anaemic, 68.4% of the patients had POG of 37-39 weeks, 21.4% had POG of <37 weeks and 10.3% had POG >=40 weeks. Further, it was observed that there was no significant difference in distribution of patients according to POG when compared between the two groups (p value 0.115).

The table 5 shows the comparison of distribution of patients according to mode of delivery between the two groups i.e. anaemic and non anaemic under the study. It was observed that under the group anaemic, 53% of the patients had LSCS as mode of delivery while 47% had NVD as mode of delivery. Under the group non anaemic, 55.6% of the patients had LSCS as mode of delivery while 44.4% had NVD as mode of delivery Further, it was observed that there was no significant difference in distribution of patients according to mode of delivery when compared between the two groups (p value 0.666).
The table 6 shows the comparison of mean birth weight between the two groups under the study. It was observed that mean birth weight of anaemic group was 2.41 ± 0.32 Kg while for non-anaemic group mean birth weight was 2.67 ± 0.39 Kg. Further, it was observed that there was a significant difference in mean birth weight when compared between the two groups (p value <0.001).
The figure 1 and 2 shows the comparison of distribution of patients according to Mother blood group (MBG) between the two groups i.e. anaemic and non anaemic under the study. It was observed that under the group anaemic, 31.7% of the patient's mother had A+ve blood group while 28.4% had O+ve, 26.2% had AB+ve and 13.7% patient's mother had blood group of B+ve. Under the group non anaemic, 17.9% of the patients mother had A+ve blood group while 0.9% had A-ve, 1.7% of the patients mother each had AB -ve, B-ve & O-ve; 20.5% had AB+ve, 28.2% had B+ve and 27.4% had blood group of O+ve. Further, it was observed that there was a significant difference in distribution of patients according to mother blood group when compared between the two groups (p value 0.001). It was observed that under the group anaemic, 21.9% of the patients had A+ve blood group while 35% had AB+ve, 17.5% had B+ve and 25.7% patients had blood group of O +ve.
Under the group non anaemic, 23.1% of the patients each had A+ve & O+ve blood group while 0.9% of the patients each had A-ve, AB+ve & B-ve, 18.8% of the patients had AB +ve,; 30.8% had B+ve and 1.7% had blood group of O-ve. Further, it was observed that there was a significant difference in distribution of patients according to baby blood group when compared between the two groups (p value 0.005). The table 5 the comparison of mean of various parameters between the two groups under the study. It was observed that there was a significant difference in mean RBC (p value <0.001), mean MCH (p value 0.001), mean MCV (p value 0.011) and mean MCHC (p value <0.001) when compared between the two groups .The table 6 shows the comparison of mean baby hemoglobin between the two groups under the study. It was observed that mean baby hemoglobin of anaemic group was 15.68 ± 1.99 while for non anaemic group mean baby hemoglobin was 17.91 ± 1.52. Further, it was observed that there was a significant difference in mean baby hemoglobin when compared between the two groups (p value <0.001). The table 8 the comparison of mean baby retic count between the two groups under the study. It was observed that mean baby retic count of anaemic group was 2.43 ± 1.03 while for non anaemic group mean baby retic count was 3.43 ± 1.12.Further, it was observed that there was a significant difference in mean baby retic count when compared between the two groups (p value <0.001).

DISCUSSION

Iron is one of the crucial micronutrient that plays a major role in transporting of oxygenated blood by production of transport proteins- hemoglobin and myoglobin.[1] Hemoglobin acts as an iron reserve and stores almost 50% of the iron molecules. Iron deficiency anaemia is a prominent maternity

disorder across the globe during pregnancy accounting for even maternal death.[3] This might be attributed to the increased concentration of hemoglobin post iron therapy. Therefore, this study was aimed at determining the association between maternal and neonatal hemoglobin. A total of three hundred pregnant females were included in the study on the basis of pre-defined inclusion and exclusion criteria. Cord blood sample was collected post delivery and analysed for hemoglobin estimation.

Gravida which is the number of times a female is or has been pregnant, regardless of the pregnancy outcome, was analysed in the present study. It was observed that primigravida was observed in 35% of the females. Females who had 2 and ≥3 gravida account 34.3% and 30.7%, respectively. In a similar study by ***Timilsina et al***, 40.36% of the females were primi parity and 59.64% were multi parity with mean age of pregnancy 26.04 ± 3.47 years.[17]

We observed gestation period of <37 weeks in 25.7% of the females, 37-39 weeks was observed in 67.3% and ≥40 weeks was observed in 7% of the females. ***Lee et al,*** in their study of 193 pregnant females observed mean gestation age to be 39.9±1.2 weeks. 21% of the female were in early term, 59% full term, 19% late term and 1% post term. Interestingly, 92% of the females in their study underwent vaginal delivery and only 8% required caesarean section.[18] Contrary to their findings, the present study observed 54% deliveries with lower segment caesarean section (LSCS) and 46% deliveries using normal vaginal delivery (NVD).

In our study, the mean weight of the baby at the time of birth was found to be 2.513 ± 0.37 Kgs. The mean hemoglobin was found to 16.55 ± 2.12 g/dL and mean retic count was 2.82 ± 1.17%. Mean RBC count, MCH count, MCV and MCHC count were 4.32 ± 1.02 million/mcL, 30.05 ± 2.18 pg, 98.33 ± 5.55 fl and 34.35 ± 1.27g/dL, respectively. Similarly, ***Bernhardt et al,*** found mean hemoglobin of the baby to be 16.84±2.43 g/dL and mean hemoglobin of mother was found to be 11.16±2.51 g/dL.[19] ***Timilsina et al***, also observed mean hemoglobin of the fetus to be 16.34 ± 2.01 g/dL and maternal hemoglobin to be 11.14 ± 1.39 g/dL.[17] Mean RBC count, MCH count, MCV and MCHV count were found to be 4.72 ± 0.59%, 34.70 ± 4.73 pg, 102.85 ± 8.58fl and 33.26 ± 1.09, respectively.[17] Approximately similar results were obtained in our study with the mean hemoglobin of the mother 10.232 ± 1.47 g/dL.

We further subdivided the females into anaemic and non anaemic groups and carried out the analysis between them. In the present study, it was observed that 61% of the mothers were anaemic and only 39% were non anaemic. A non-significant difference in the gravida was observed between the anaemic and non anaemic women (p=0.111) with majority of anaemic women (35%) having ≥3 gravida and non anaemic women (39.3%) having 2 gravida. Period of gestation was also not significantly different between anaemic and non anaemic females (p=0.115) with majority of women having 37-39 weeks of gestation in both the groups (66.7% vs 68.4%). Mode of delivery was almost similar between the two groups (53% LSCS in anaemic and 55.6% in non anaemic; 47% NVD in anaemic and 44.4% in non anaemic). A non-significant association was observed between mode of delivery and anaemic and non anaemic group (p=0.666).

Birth weight of the baby largely determines the mortality in the first year of life and therefore, indicates the efficiency with which a female has carried her baby.[20] Interestingly, the mean birth weight of child born from non anaemic women was significantly higher compared to anaemic (2.67 ± 3.89 vs 2.41 ± 3.18 kg; p=<0.001). Similar results were also obtained by ***Sekhavat et al,*** wherein they observed that anaemia was significantly associated with low birth weight of the children (p=0.01).[21] ***Paramahamsa et al***, also reported significantly lower birth weight in babies born to anaemic mothers (p<0.05).[22]

In our study, a significant difference was also observed in maternal blood group when compared between anaemic and non anaemic women (p=0.001). Majority of anaemic women had A positive blood group (31.7%) and non anaemic women had B positive blood group (28.2%). Blood group of babies was also significantly different when compared between anaemic and non anaemic mothers (p=0.005). Majority of anaemic women had babies with AB positive blood group (35%) and non anaemic women had babies with B positive blood group (30.8%).

The count for RBCs (3.93 ± 0.88 vs 4.92 ± 0.93; p<0.001), MCH (33.73 ± 2.16 vs 34.55 ± 2.14; p=0.001), MCV (97.69 ± 4.80 vs 99.35 ± 6.43; p=0.011) and MCHC (34.11 ± 1.20 vs 34.73 ± 1.27; p<0.001) was found to be significantly higher among non anaemic women.
A significant difference was observed in the mean hemoglobin and retic count of the babies when compared between anaemic and non anaemic mothers (p<0.001 each). ***Bernhardt et al***, also observed a significant association of mean hemoglobin of the fetus between anaemic and non anaemic mothers (p=0.00).[19]

CONCLUSION

The present study concludes that hemoglobin of mother and the baby are significantly and positively correlated. Other blood related parameters like retic count, RBC count, MHC, MCV and MCHC were also significantly correlated between mother and fetus. Interestingly, these parameters appeared to be significantly higher among non anaemic women. Therefore, it can be suggested that anaemic women should intake more iron during pregnancy for the normal levels of hemoglobin and other parameters in the baby also. However, these findings are primary and hence require further validation with the help of more large cohort trials and studies.

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