The inter-relationship hematological parameters between Saudi newborns and parents

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ABSTRACT

Objective: To determine the relationship of the hematological parameters between Saudi newborns and their parents.

Methods: This study was carried out at King Khalid University Hospital, Riyadh, Kingdom of Saudi Arabia, over a one-year period. Venous blood samples were taken from 82 healthy Saudi pregnant women in labor at full term, their husbands, and umbilical cord blood after delivery. Estimation of the hematological indices, in addition to transferrin level were performed.

Results: A statistically significant correlation was found between parents and cord blood with regards to red blood count, mean corpuscular volume, mean corpuscular hemoglobulin, mean corpuscular hemoglobulin concentration and packed cell volume, while no correlation was found with hemoglobulin and transferrin.

Conclusion: Some of the hematological indices could be mainly genetically determined including red blood count, mean corpuscular volume, mean corpuscular hemoglobulin concentration, and packed cell volume as significant correlation was found between parents and their newborns while hemoglobulin and transferrin levels were not as these variables are mainly affected by environmental factors.

Keywords: Newborn, hemoglobin, transferrin.

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The hematological values of newborns depend on several factors, including the ethnic group, maternal health, nutritional status and antenatal complications such as anemia, growth restriction and fetal infections. In addition, intrapartum factors including asphyxia[1] play an important role. A few studies have correlated hematological parameters of pregnant mothers with those of their newborns, using total hemoglobin level and iron status, either in anemic patients or in patients who had iron supplementation. However, correlation of hematological parameters between healthy mothers and their newborns were not encountered in the literature.

We conducted this study in order to correlate the hematological parameters and transferrin (TFR) levels of uncomplicated non-anemic pregnant mothers, who were not on iron supplementation, with their newborns and with the father's hematological profile.

Methods. Eighty-two healthy Saudi pregnant ladies in this study were regularly monitored at the

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Outpatient clinics of King Khalid University Hospital, Riyadh, Kingdom of Saudi Arabia (KSA). Only women with an uncomplicated pregnancy were included. A 5-10 ml of blood was drawn at delivery by venepuncture in tubes containing ethylenediaminetetraacetic acid (EDTA) as an anti-coagulant from the mothers and the fathers, after an informed consent was taken from concerned parents. All mothers gave birth at full term vaginally. All mothers were non-smokers and did not receive iron supplementation antenatally, and had hemoglobin level >11g/l during their pregnancy. Umbilical cord blood was collected immediately after delivery from the placental end (discarding the first 2 mls) after early ligation of the cord, raising the baby to the level of the placenta to avoid feto placental transfusion and vice versa. The blood was used for analysis of the hematological parameters on Coulter Counter ZF6 with a hemoglobinometer attachment. The hematological indices investigated included total hemoglobin level (Hb), red blood cells count (RBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), white blood count (WBC), and packed cell volume (PCV). The blood was centrifuged at 1000 revolutions per minute and the plasma and cells were carefully separated for biochemical investigation.

The plasma was stored at –20°C until required for analysis. The red cells were washed twice with cold physiological saline and hemolyzed using cold distilled water. The hemolysate was used to screen for sickle cell hemoglobin (HbS) and other abnormal hemoglobins by electrophoresis in alkaline (Marengo Rowe)[2] and acid pH (Robinson).[3] Transferrin (TFR) levels were measured by radial immunodiffusion (RID) using commercially available plates. The activity of glucose 6-phoshate dehydrogenase (G6PD) was determined spectrophotometrically using kits from Boehringer Mannheim.

The laboratory tests were carried out in a hospital laboratory, which run an internal and external quality control.

Statistical analysis was carried by using statistical analysis system program on main frame computer at King Saud University, Riyadh, KSA. Regression and correlation analysis were carried out by General Linear Model (GLM) program.

Results. The mean age of the mothers was 26.9 years (+5.79) (range 16 years - 40 years). The mean parity was 0.481 (+1.35) (range 0-9) and the mean gestational age at delivery was 39.47 weeks (+1.78) (range 36-43 weeks).

Table 1 presents the descriptive statistics mean, standard deviation, ranges, confidence limit and statistical significance of the hematological parameters of the parents and their newborns. The total hemoglobin, MCV, MCH, MCH, PCV and WBC in the cord blood were higher than in both parents, while the TFR level was significantly lower.

Table 1 - Descriptive characteristics of parents and cord blood hematological parameters.

Parameter		Mean	Standard deviation	Non-parametric range 2.5-97.5%	Confidence Limit Cord & Mother	Confidence Limit Cord & Father	Confidence Limit Mother & Father
Hb (g/dl)	C	16.35	1.55	13.2-18.9	0.01-6.73*	0.0-0.94*	0.0-5.8*
	M	12.98	1.33	10.5-15.5			
	F	15.88	1.27	11.4-18			
RBC ($x10^{12}/1$)	C	3.96	0.56	3.08-4.87	0.0-0.0	0.004-1.69	0.0-1.7
	M	3.96	0.49	2.99-4.99			
	F	4.81	0.55	3.86-5.93			
MCV (fl)	C	99.97	6.75	86-114	0-183.6*	0.05-37.05*	1.0-1.25
	M	80.17	9.81	67-95			
	F	81.42	5.82	67-92			
MCH (pg)	C	41.59	4.65	34-51	3.87-21.125*	0.01-16.91*	0.0-0.86
	M	32.95	4.22	25-39			
	F	33.38	3.83	24-41			
MCHC (g/dl)	C	37.17	4.12	31-46	0.02-1.6	1.0-1.14	0.0-0.48
	M	36.36	3.81	30-44			
	F	36.6	3.87	30-43			
WBC ($x10^9/1$)	C	12.19	3.53	5.9-17.8	0-1.3	0.01-8.09*	0.0-6.84*
	M	11.56	3.94	4.9-21.8			
	F	8.14	2.48	4.3-13.9			
PCV (%)	C	44.39	6.46	32-54	0.03-17.1*	0.07-2.02	0.0-15.13*
	M	35.82	4.89	27-45			
	F	43.38	5.1	31-53			
TFR (g/l)	C	27.81	13.8	10.8-53.2	0.08-129*	0.02-205.6	0.07-7.87*
	M	92.39	17.7	9.61-97.2			
	F	96.36	0.22	94.4-97			

Hb - hemoglobin, RBC - red blood cells, MCV - mean corpuscular volume, MCH - mean corpuscular hemoglobin, WBC - white blood cells MCHC - mean corpuscular hemoglobin concentration, PCV - packed cell volume, TFR - transferrin, * statistically significant, c - cord, m - mother, f - father

Red cell count in the cord blood was the same as in the mother's blood, but was lower than in the fathers (3.96) in the mother and cord blood versus 4.81 in fathers. There was a statistically significant difference in the Hb and TFR levels between mothers and cord blood and fathers and cord blood, while only a statistically significant difference was found in the levels of MCV and MCH between them.

Table 2 shows the correlation between mother and cord blood hematological parameters. There was statistically significant correlation between the 2 with regards to RBC (P=0.0002), MCV (P-0.002), MCH (P=0.0001), MCHC (P=0.0001, PCV (P=0.001) and WBC (P=0.02). On the other hand, there was no statistically significant correlation with regards to Hb (P=0.24) and TFR (P=0.26).

Table 3 shows the correlation between the father and cord blood. There was statistically significant correlation between the 2 with regards to RBC (P=0.001), MCH (P=0.0001), MCHC (P=0.0001), MCV (P=0.04), and PCV (P=0.0001), while there was no significant correlation between them with regards to Hb (P=0.8), WBC (P=0.87) and TFR (P=0.33).

Table 4 shows the correlation between mothers and fathers blood. There was statistically significant correlation between the 2 with regards to RBC (P=0.0005), MCH (P=0.0009), MCHC (P=0.0001) and PCV (P=0.0001), while no statistically significant difference was found with regards to Hb level, MCV, WBC, and TFR.

Discussion. The sole source of nutrients for the growing fetus is the maternal blood. Several studies have shown correlation between cord blood hemoglobin level and transferrin values in the mothers suffering from an anemic state.[4] However, other studies have failed to show any significant correlation.[5,6] Wong and Saha[6] reported that mothers with a reduced store of iron at term still manage to provide sufficient iron for the fetus.

On the other hand, in the study by Devi et al[7] and co-workers, no statistically significant correlation could be demonstrated between cord blood and maternal hemoglobin level.

Lao et al[8] studied hematological and biochemical parameters in newborns and their mothers and showed that all values were higher in the cord blood compared to the mothers. Only maternal MCV and MCH correlated with cord serum iron. They suggested that maternal hematological and iron indices are not predictive of the hemoglobin or iron status of the newborns and the fetus continues to take up iron from the mother until delivery.

Our study was carried out on non-anemic mothers and the results show no correlation between transferrin level in cord blood and maternal blood. This is in agreement with the findings of several

Table 2 - The correlation between mothers and cord blood hematological parameters.

Parameter	r	r2	P value
Hemoglobulin	0.14	0.02	0.24
Red blood cells	0.44	0.19	0.0002*
MCV	0.36	0.13	0.002*
MCH	0.66	0.44	0.0001*
MCHC	0.78	0.61	0.0001*
Packed cell volume	0.47	0.223	0.0001*
White blood cells	0.27	0.071	0.02
TFR	0.4	0.019	0.26

* statistically significant, r - correlation co-efficient
MCV - mean corpuscular volume
MCH - mean corpuscular hemoglobin
MCHC - mean corpuscular hemoglobin concentration
TFR - transferrin

Table 3 - The correlation between the fathers and cord blood hematological parameters

Parameter	r	r2	P value
Hb	0.03	0.0009	0.8
RBC	0.59	0.35	0.0001*
MCV	0.24	0.06	0.04
MCH	0.57	0.33	0.0001*
MCHC	0.57	0.33	0.0001*
PCV	0.56	0.32	0.0001*
WBC	0.02	0.00003	0.87
TFR	0.12	0.015	0.33

* statistically significant, r - correlation co-efficient
Hb - hemoglobin
RBC - red blood cells count
MCV -mean corpuscular volume
MCH - mean corpuscular hemoglobin
MCHC - mean corpuscular hemoglobin concentration
PCV - packed cell volume
WBC - white blood count, TFR - transferrin

Table 4 - The correlation between mother and fathers blood.

Parameter	r	r2	P value
Hb	0.03	0.0009	0.8
RBC	0.59	0.35	0.0001*
MCV	0.24	0.06	0.04
MCH	0.57	0.33	0.0001*
MCHC	0.57	0.33	0.0001*
PCV	0.56	0.32	0.0001*
WBC	0.02	0.00003	0.87
TFR	0.12	0.015	0.33

* statistically significant, r - correlation co-efficient
Hb - hemoglobin, RBC - red blood count
MCV - mean corpuscular volume, MCH - mean corpuscular hemoglobin
MCHC - mean corpuscular hemoglobin concentration
PCV - packed cell volume, WBC - white blood count
TFR - transferrin

other studies.[6] Transferrin is a protein that transports iron and is present in the Yolk sac of the early embryo in a form that is immunologically similar to that present in sera of the adult. Its level increases progressively throughout pregnancy to reach maximum level just before term.[9] Iron is transported in one way from the mother to the fetus against concentration gradient. The iron storage in the fetus and mother are not directly related and they are under control of an independent system.[10]

This study on cord blood of normal healthy, non-anemic females showed that a statistically significant positive correlation exists for RBC, MCV, MCH, MCHC and PCV between the mothers' blood and cord blood. Interestingly the cord blood values also correlated positively with the paternal values. This indicates that these values could be mainly genetically determined while there was no correlation between Hb level and TFR level as these 2 variables which are affected by maternal condition such as iron status and antenatal complication. Of interest is the up regulation of TFR receptor synthesis in those cases, which enables placenta to compete more effectively with erythroid marrow of the pregnant woman[11] for circulating TFR iron.

Of interest is that no significant correlation was found between mothers and fathers level of HBO, MCV, WBC and TFR as these values are affected by environmental and nutritional factors. The statistically significant higher mean values of TFR between mothers and fathers agrees with previous studies that found higher values of TFR in male neonates than females.[12] It will be of a great value to follow those babies and correlate the same hematological values as adults with their values as newborns and their parents again. Furthermore a correlation study of the hematological values of the same mothers and all siblings at birth is also recommended.

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