

Research Article

## Maternal anaemia during pregnancy and its impact on perinatal outcome

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### Abstract

**Back ground:** Severe anaemia is associated with negative impact on both the mother and the newborn. Foetal anaemia, low birth weight, preterm birth and still birth have been associated with anaemia. Women with iron deficiency are particularly susceptible to iron deficiency anaemia during pregnancy. Apart from that there was no consistency in the timing of haemoglobin considered for analysis. So we designed a study to look into these aspects.

**Material and methods:** The study was carried out in obstetrics and gynaecology department of B. J. Medical College, Ahmedabad. A total number of 105 pregnant women, attending OPD were taken. 90 of them registered for antenatal clinic in the first trimester. The remaining 15 reported for registration only in 3<sup>rd</sup> trimester. Blood was collected from all the subjects to measure the haemoglobin concentration between 16-18 weeks, 22-24 weeks and 34-36 weeks of pregnancy. Hematocrit and RBC were measured between 34-36 weeks and all the haemoglobin indices were calculated.

**Results:** The prevalence of anaemia among pregnant women in this study was 71.43% with severity of anaemia higher in age between 25-30 years. The severity of anaemia that developed in the last trimester was closely related to haemoglobin levels found in the first trimester.

**Conclusion:** The hematocrit, RBC count and haemoglobin indices were lower in women who did not received iron supplementation which was highly significant. Iron supplementation decrease the fall as compared to the group without iron supplementation. Antenatal care should be made available to pregnant women in both urban and rural areas.

**Keywords:** Maternal anaemia, low birth weight, preterm birth, still birth, apgar score

### 1. Introduction

Anaemia is a common medical problem in pregnancy. The extent up to which maternal anaemia affects maternal and neonatal health is still uncertain<sup>1</sup>. India has reported high prevalence of anaemia in pregnancy. In one of the studies conducted on a large population, it was estimated that 87% of the Indian population of the Indian women are anemia<sup>2</sup>. Iron deficiency anaemia is a health problem that often goes untreated especially in pregnant women living in developing countries where it can be most dangerous. The world health organization estimates that averages of 56% of pregnant women in developing countries are anemic<sup>3</sup>. Iron deficiency during pregnancy is thought to be caused by combination of factors such as previously decreased iron supply, the iron requirements of growing foetus and expansion of maternal plasma volume<sup>4</sup>.

It is estimated that <50% of women do not have adequate iron stores for pregnancy. Because the iron required for pregnancy (3-4mg/day) is substantial, risk of iron deficiency and IDA should increase with gestation<sup>5</sup>. During pregnancy, anaemia increase >4 fold from the 1<sup>st</sup> to 3<sup>rd</sup> trimester in the low income when monitored as part of pregnancy nutritional surveillance by the CDC<sup>6</sup>. It is a well established fact that there is a physiological drop in haemoglobin (Hb) in the mid trimester. This physiological drop is attributed to increase in plasma volume and hence decrease in blood viscosity. This aids in better circulation in placenta. The nadir of this drop is variable, and hence there was a need for criteria for detecting anaemia in pregnancy<sup>1</sup>.

While plasma volume and red blood cell mass both known to expand during pregnancy plasma volume grows to a greater extend, therefore diluting the maternal haemoglobin concentration<sup>7</sup>. Research has found that Hb and Hct concentrations typically decrease during the first trimester reach the lowest levels at the end of second trimester and increase again during the third trimester of pregnancy<sup>8</sup>.

The Centre for Disease Control has used this research to establish trimester based specific haemoglobin concentration adjustments for diagnosing anaemia in pregnancy. Hb adjustments for an unknown trimester dating have been developed by the WHO<sup>9</sup>.

Trimester of pregnancy	Haemoglobin adjustment(g/dl)
First	-1.0g/dl
Second	-1.5g/dl
Third	-1.0g/dl
Unknown trimester	-1.0g/dl

WHO has defined haemoglobin of less than 110g/L as anaemia in pregnancy<sup>10</sup>. Hitherto, anaemia in pregnant women has been regarded as detrimental to the foetal growth and pregnancy outcomes. Low birth weight and preterm delivery has been persistently linked to anaemia in pregnancy<sup>10,11,12,13</sup>.

A meta-analysis showed that anaemia during early pregnancy, but not during late pregnancy is associated with slightly increased risk of preterm delivery and low birth weight<sup>14</sup>.

Thus though there are defined criteria for anaemia during pregnancy, it is still not clear which trimester hematocrit level should be taken as standard for assessment. The present study was designed to observe the effect of haemoglobin and hematocrit levels during various trimesters and that can help for better pregnancy outcome and foetal growth.

## 2. Methods and materials

The study was carried out at civil hospital, Ahmedabad in patients attending OPD of Obstetrics and Gynaecology department. 105 pregnant women were included in the study. 90 of them registered Antenatal clinic in the 1<sup>st</sup> trimester. The remaining 15 reported for registration only in the 3<sup>rd</sup> trimester. Patients were aged between 20-30 years and of singleton pregnancy. Women with past history of preterm delivery, obstetrics complications and medical illnesses except anaemia were excluded from the study. Detailed history including literacy and socioeconomic status was noted. All the women were divided into 2 groups:

**Group A:** Included women who registered in the antenatal clinic between 12-16 weeks and had regular follow up. They received oral iron supplementation (60 mg OD).

**Group B:** Included women who registered late in pregnancy between 34-36 weeks of gestation.

According to the level of haemoglobin we have divided them into 4 groups.

- Group 1. > 10.1 gm/100ml (control group)
- Group 2. 8.1-10 gm/100ml (mild anaemia)
- Group 3. 6.5-8 gm/100ml (moderate anaemia)
- Group 4. <6.5 gm/100ml (severe anaemia)

Blood was collected from all the subjects to measure the haemoglobin concentration between 16-19 weeks, 22-24 weeks and 34-36 weeks of gestation. Hematocrit, haemoglobin indices and RBC count were measured with the help of most recently used blood cell counters in last trimester. The name of instrument used in this study is Sysmex Transasia F 620.

### 2.1. Haemoglobin measurement

In this instrument haemoglobin is measured by modified Drabkin's reagent test. Contents for this reagent are potassium phosphate, potassium ferricyanide and potassium cyanide. This reagent converts haemoglobin to cyanmethemoglobin. Potassium phosphate shortens the conversion time to 3 minutes and minimizes the turbidity and enhances the red cell lyses.

### 2.2. Total RBC count

The method for RBC count in this instrument is impedance counting, which depends on the fact that RBC'S are poor conductor of electricity whereas certain diluents are good conductors. For a cell count, blood is highly diluted in a buffered electrolyte solution. The flow rate of this diluted sample is controlled by displacement of a tightly fitting piston. The external vacuum initiates movement of a mercury piston which causes major volume of the sample to flow through an aperture tube of specific dimension. By means of constant source of electricity a direct current is maintained between two electrodes in the chambers surrounding the aperture tube and the other inside the aperture tube when blood cell is carried through the aperture. This produces a corresponding change in the potential between electrodes which lasts as long as the red cell passes through the aperture. The number of pulses produced indicates the RBC passing through and displayed on an oscillograph screen.

### 2.3. Packed cell volume (PCV)

With automated instruments, the derivation of RBC, PCV and MCV are closely interrelated. The passage of cell through the aperture of an independence counter leads to the generation of an electrical impulse. The height of which is proportional to cell volume.

### 2.4. Calculation of indices done as follows:

Indices	Calculation	Normal value
MCV (mean corpuscular volume)	$\text{PCV}(\text{100ml blood})/\text{RBC count}(\text{million/cumm}) \times 10$	90 $\mu\text{m}^3$ (78-94 $\mu\text{m}^3$ )
MCH (mean corpuscular haemoglobin)	$\text{Hb}(\text{gm}\%) / \text{RBC}(\text{million/cumm}) \times 10$	30pg(28-32pg)
MCHC (mean corpuscular Hb concentration)	$\text{Hb}(\text{gm}\%) / \text{PCV}(\text{100ml blood}) \times 100$	33 % ( 35 $\pm$ 3%)

### 2.5. Statistical method

Data were entered into a computer database using SPSS software. Comparison between categorical variables were made using the  $\chi^2$  - test and between quantitative variables using the independent t-test. A p-value of less than 0.05 was considered statistically significant.

## 3. Results

In our present study, 105 pregnant women were selected and changes in haemoglobin and hematocrit concentration during 3 trimesters were studied.

**Table 1: Comparison of changes in haemoglobin concentrations (Mean  $\pm$  SD) during the 3 trimesters**

	Haemoglobin concentration(gm/dl)						
	Control		Mild		moderate		Severe
1 <sup>st</sup> trimester	10.45 $\pm$ 1.008	-	9.6 $\pm$ 1.38	-	8.24 $\pm$ 1.06	-	-
2 <sup>nd</sup> Trimester	9.94 $\pm$ 1.003	P=0.02 With 1 <sup>st</sup>	9.41 $\pm$ 1.76	P=.38 with 1 <sup>st</sup>	8.38 $\pm$ 0.94	P=0.6 with 1 <sup>st</sup>	-
		P=0.000 with 3 <sup>rd</sup>		P=0.33 with 3 <sup>rd</sup>		P=0.00 with 3 <sup>rd</sup>	
3 <sup>rd</sup> Trimester	11.28 $\pm$ 0.71	P=0.000 with 1 <sup>st</sup>	8.77 $\pm$ 0.71	P=0.05 with 1 <sup>st</sup>	7.29 $\pm$ 0.05	P=0.000 with 1 <sup>st</sup>	4.88 $\pm$ 0.97

According to our study the haemoglobin levels in the control group in 1<sup>st</sup> trimester showed a rise in 2<sup>nd</sup> trimester. Subsequently the haemoglobin level showed a rise in 3<sup>rd</sup> trimester and it was found to be similar to the 1<sup>st</sup> trimester. In the group who had haemoglobin level of 9.6 $\pm$ 1.38 at 12-16 weeks, it fell to 9.41 and 8.77 in the 2<sup>nd</sup> and 3<sup>rd</sup> trimester respectively. Similarly, the haemoglobin levels of 8.24 $\pm$ 1.06 at 12-16 weeks, had haemoglobin levels of 8.38 $\pm$ 0.94 and 7.29 $\pm$ 0.05 in the 2<sup>nd</sup> and 3<sup>rd</sup> trimester.

**Table 2: Haemoglobin concentration and blood indices in non-anaemic group compared to mild-moderated anaemia**

	Haemoglobin (gm/dl)	RBC (millions/ mm)	PCV (%)	MCV (fl)	MCH (pg)	MCHC (%)
Control	11.28±0.7	4.25±0.38	32.54±3.75	77.53±6.53	26.49±3.64	34.66±4.15
Mild-moderate	8.03±0.96	3.89±0.45	26.8±2.07	65.66±10.51	21.06±3.63	31.89±2.85
p-value	0.00	0.0002	0.00	0.00	0.00	0.01

The table no.2 shows that the RBC count and hematocrit (PCV) were lower in the patients with mild to moderate anaemia. The MCV and MCH were slightly lower in the control group but it was also lower in patients with anaemia. The MCHC in the control group is within normal limits but it is slightly lower in the group with mild and moderate anaemia.

**Table 3: Correlation of anaemia and birth weight**

Birth weight	Correlation of haemoglobin and birth weight in three trimesters													
	1 <sup>st</sup> trimester				2 <sup>nd</sup> trimester				3 <sup>rd</sup> trimester					
	>12	>10	8-10	≤8	>12	>10	8-10	<-8	>12	10-12	8-10	6-8	<6	
LBW	2	9	20	12	1	5	23	3	2	13	4	19	11	
NBW	1	17	18	11	1	8	27	12	4	11	19	19	3	

The Table no.3 suggests that birth weight has a direct correlation with prevalence of anaemia and the association is statistically significant in all the three trimesters.

**Table 4: Relation of anaemia and preterm birth**

Weeks of gestation	Haemoglobin												
	1 <sup>st</sup> trimester				2 <sup>nd</sup> trimester				3 <sup>rd</sup> trimester				
	>12	>10	8-10	≤8	>12	>10	8-10	≤8	>12	10-12	8-10	6-8	<6
Preterm	0	8	9	6	1	4	13	10	2	3	6	16	10
Term	2	17	25	17	1	7	33	15	2	15	16	20	4
Post term	1	1	4	0	0	2	4	0	2	1	1	2	0

According to our study, in the 1<sup>st</sup> trimester the proportion of preterm birth was higher in women with haemoglobin between 10 and 12gm/dl, but in the 2<sup>nd</sup> trimester maximum preterm birth occurred in women with haemoglobin >12gm/dl. In the 3<sup>rd</sup> trimester increased rates of preterm delivery is seen at both the ends of haemoglobin range, irrespective of the gestation at registration.

**Table 5: Relation of apgar score and haemoglobin concentration on 3<sup>rd</sup> trimester**

Apgar score	Non-anaemic	Mild Anaemia	Moderate anaemia	Severe Anaemia
0-2 (severe asphyxia)	0	0	1	2
3-4 (Moderate asphyxia)	0	0	3	1
5-7 (mild asphyxia)	2	4	4	5
8-10 (No asphyxia)	28	2	22	4

According to this 93.33% of infants of non-anaemic mothers showed an apgar score 8-10 at one minute, whereas only 72.33% of infants born to anaemic mothers had a similar score. In the non-anaemic group, no infant had either moderate if severe asphyxia. Neonatal deaths were found only in case of infants of mothers with severe anaemia. All the three cases of severe asphyxia in the present study died soon after birth.

#### 4. Discussion

The trend in the haemoglobin concentration is quite interesting. The mid-trimester drop seen in non anaemic mother was not seen in anaemic mother. This indicates that mid-trimester drop in a haemoglobin is a very essential physiologic arrangement. However in anaemic mothers, as the mean haemoglobin in the mid-trimester was below that in non anaemic mothers, no drop phenomenon was seen. This suggests that there may be a narrow range of what the haemoglobin should be in order to have good outcome<sup>1</sup>.

There is a substantial amount of evidence showing that maternal iron deficiency anaemia early in pregnancy can result in low birth weight subsequent to preterm delivery<sup>15</sup>. For example, Welsh women who were first diagnosed with anaemia (Hb <104g/dl) at 13-24 weeks of gestation had a 1.18-1.75 fold higher relative risk of preterm birth, low birth weight and prenatal mortality<sup>16</sup>.

The slightly lower values of MCV and MCH in control group indicate a borderline case of iron deficiency anaemia. All the subjects in the control group and mild and moderate anaemia received ANC and Iron supplementation. Lower values of MCV, MCH and MCHC were found in group not taking iron supplementation compare to that taking iron supplementation was highly significant. Some of the increase in anaemia and iron deficiency anaemia with gestation is an artefact of the normal physiologic changes of pregnancy<sup>17</sup>. Although the maternal red cell mass and plasma volume both increase during gestation, they do not do so simultaneously. Haemoglobin and hematocrit decline throughout the 1<sup>st</sup> and 2<sup>nd</sup> trimesters, reach their lowest point late in the second to early in the 3<sup>rd</sup> trimester and then rise again nearer to term<sup>18</sup>.

It is thus becoming clearer that the best time to detect any risk associated with maternal anaemia may be early in pregnancy. Furthermore, this study should be used as an evaluation of pregnancy outcome in relation to maternal haemoglobin concentration. The data demonstrate that maternal anaemia was significantly associated with the health of infant at birth and anaemic women gave birth to infants with lower apgar scores at 1 and 5 minutes following birth than healthy pregnant women.

#### 5. Summary and conclusion

The haemoglobin concentration fell progressively but subsequently rose to almost to the haemoglobin level at early pregnancy, in case of the control group. The anaemia which developed progressively during pregnancy was more severe in women who had lower haemoglobin

levels in the 1<sup>st</sup> trimester. In those who received iron supplementation the fall of Hb was less as compare to those who did not receive iron supplementation. The hematocrit, RBC count and Hb indices were, lower in women who did not receive iron supplementation.

The minimum incidence of preterm birth was noted in association with Hb concentration between 8-10 g/dl. The birth weight of baby has a direct relation with severity of anaemia. A U- shaped association was observed between maternal Hb and birth weight. Maternal Hb concentration showed a significant association of apgar score with birth asphyxia.

So this study confirm that prevalence of anaemia increase as the pregnancy progresses and that a normal value at 1<sup>st</sup> booking in 1<sup>st</sup> trimester should not be considered sufficient, as further Hb values should be indicated and observe during the course of pregnancy which results in better monitoring of pregnancy in the form of early detection of anaemia and its correction. This will help to reduce foetal morbidity and mortality.

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