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CORRELATION OF MATERNAL HEMOGLOBIN CHANGES DURING PREGNANCY WITH BIRTH WEIGHT

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ABSTRACT

Background And Objectives: Birth weight is one of the important and easily accessible variables in epidemiology. Mortality risk during the first year of life and upto certain extent, the risk of various diseases and developmental problems in childhood can be attributed to low birth weight. Studies have reported that severe anemia during 'early' pregnancy is associated with adverse birth outcomes such as low birth weight[2,3,4,5]. At the same time, many other studies showed no such association [6,7,8,9]. Some studies reported that hemoglobin levels at 'mid' or 'late' pregnancy are inversely associated with birth weight [7,10,11,12]

Even in healthy pregnant women, the lack of increased plasma volume during pregnancy is associated with low birth weight and increased risk of delivering small for gestational age infants[13,14,15]

In this study we are going to determine the association between maternal hemoglobin changes and birth weight.

Methods: Between June 2021 and Jan 2022, 162 antenatal cases from MIMS, vizianagaram Obstetrics opd were enrolled in this study. Hemoglobin levels are sampled during antenatal checkups. Early hemoglobin before 16 weeks, mid - hemoglobin from 16- 27 weeks 6 days and late hemoglobin after 28 weeks were taken. Correlation was established using statistical analysis.

Results: 75.9% babies were >2,500 gms, out of which 63% had intermediate reduction in mid-early change in hemoglobin distribution while 29% had least reduction. 24% babies were < 2,500 gms, among them 71% had least reduction in mid-early hb change in hemoglobin distribution. 52% had intermediate reduction, out of which 90% had >2,500 gms birth weight. Despite least reduction in late-early hb levels 89 newborns had birth weight >2,500 gms. Only 22.2% of low birth weight newborns had least reduction in late-early hb levels.

Conclusion: We found that failure or inadequate expansion of plasma volume from early to mid trimester results in low birth weight babies in our study. Mid- early hemoglobin changes are more statistically significant than late- early hemoglobin changes.

KEYWORDS : Mid-early hb changes, late-early hb changes, birth weight, Normal fetal growth and birthweight are directly correlated with the degree of plasma volume expansion[21,22,23,24]

INTRODUCTION:

The relation between maternal anemia and birth weight has been an area of constant interest and controversy in many studies. A U-shaped association was observed in several studies between maternal hemoglobin concentrations and birth weight.

Associations between hemoglobin levels during pregnancy and birth outcomes might differ based on the stage of pregnancy assessed. Some of the increase in anemia and iron deficiency anemia with gestation is an artifact of the regular physiologic changes of pregnancy.

Even in healthy pregnant women, the lack of increased plasma volume during pregnancy is associated with low birth weight and increased risk of delivering small for gestational age infants.

Plasma volume expansion is a well-documented aspect of pregnancy physiology essential to supporting successful pregnancy outcomes. PVE begins as early as six weeks of gestation, peaks around 32 weeks of gestation, and plateaus until delivery PVE, along with an increase in red cell volume, which is driven by erythropoietin, results in expansion of total blood volume in pregnancy.

Failure of maternal PVE has been implicated in adverse obstetric outcomes such as pregnancy pre-eclampsia, fetal growth restriction, preterm birth.

Normal fetal growth and birthweight are directly correlated with the degree of plasma volume expansion[21,22,23,24]

However, the impact of changes in hemoglobin levels from early to mid or late pregnancy on birth outcomes has not been investigated. We hypothesized in this study that changes in hemoglobin levels are an effect of increasing maternal plasma volume and protected from adverse consequences, including low birth weight, small for gestational age, and premature births. Our study aims to determine the causal relationship between maternal hemoglobin changes and birth weight and gestational age.

MATERIALS AND METHODS

The study was conducted from June 2021 to Jan 2022 as a observational longitudinal study in pediatrics and obstetrics and gynecology OP and IP. Singleton pregnancies, pregnant women registered with OBG department, MIMS, Vizianagaram, willing to participate in the study and delivered between 34 to 41 weeks and pregnant women with Hb estimated before 16 weeks of gestation were included in this study. Booked cases that are not regular, pregnant women with co-morbidities such as chronic hypertension, cardiac failure, gestational diabetes, bleeding disorders, or any acute or chronic systemic infections, newborn with congenital anomalies and stillbirths were excluded.

METHOD:

After taking informed consent, the registered singletons pregnant women are included in our study before 16 weeks of gestation. Hemoglobin levels are sampled during antenatal checkups. The first sample for Hb estimation is collected before 16 weeks (early Hb), the second sample is collected between 16 weeks 0 days and 27 weeks six days (mid-Hb), and the third sample for Hb is taken after 28 weeks, (late Hb) .

The difference in the hemoglobin levels are calculated as mid minus early and late minus early, respectively, and tabulated. The calculated

change in Hb is grouped as least reduction (> -1.0 change Hb g/dl), intermediate reduction (< -1.9 to < -1.0 change Hb g/dl) and significant reduction (<-1.9 change Hb g/dl) based upon difference between late and early Hb values.

Pregnancy outcomes are recorded in terms of birth weight. The weight of the baby is taken by the electronic baby scale after completing the physical examination. Low birth weight is defined as birth weight less than 2500 grams.

Table 1: Birth Weight And Maternal Early Hb Comparison

Maternal early Hb	<2500 gms	>2500 gms	Total
<7.9	2	1	3 (1.85%)
8-10	23	17	40 (24.6%)
10-12	14	69	83 (51.2%)
>12	0	36	36 (22%)
Total	39	123	162 (100%)
Chi- square = 41.20 , p=<0.0001* , Statistically significant			

A statistically significant correlation was observed between birth weight and maternal earlyhemoglobin as the P value calculated to be less than 0.05.

51% of babies had early maternal hemoglobin levels between 10-12 g/dl. 23 newborns (14%), born to mothers with early hemoglobin level of 8 to 10 g/dl were <2500grams.

Table 2: Birth Weight And Maternal Mid Hb Comparison

Maternal mid Hb	<2500 gms	>2500 gms	Total
<7.9	3	3	6 (3.7%)
8-10	26	41	67 (41.35%)
10-12	8	75	83(51.23%)
>12	2	*4*	6 (3.7%)
Total	39	123	162 (100%)
Chi- square = 19.90 , p=<0.0001* , Statistically significant			

The majority of newborns are concentrated in the hemoglobin range of 8 to 12 g/dl. 51.23% are in the range of 10-12 g/dl. Out of them, 75 newborns were >2500 grams and8 are <2500 grams.

Table 3: Birth Weight And Maternal Late Hb Comparison

Maternal Late Hb	<2500 gms	>2500 gms	Total
<7.9	2	1	3 (1.9%)
8-10	23	25	48 (29.6%)
10-12	9	51	60 (37%)
>12	5	46	51 (31.48%)
Total	39	123	162 (100%)
Chi- square = 26.29, p=<0.0001* , Statistically significant			

A statistically significant correlation was observed between birth weight and maternal early hemoglobin as the P value calculated to be less than 0.05.

Table 4: Birth Weight And Maternal Mid-early Hemoglobin Change Comparison

Mid early change in g/dl	<2500 gms	>2500 gms	Total
Greatest reduction <1.9 g/dl	3	10	13
Intermediate reduction <-1.0->-1.9 g/dl	8	77	85 (52.4%)
Least reduction >-1.0 g/dl	28	36	64
Total	39	123	162 (100%)
Chi- square = 23.56 , p=<0.05* , Statistically significant			

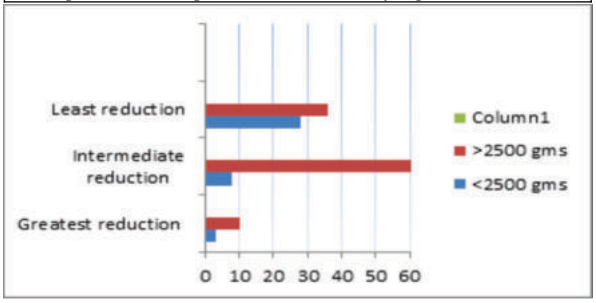

Figure 1: Birth Weight And Maternal Mid-early Hemoglobin Change Comparison

Out of 123(79%) who had birthweight>2500 grams, the majority, i.e., 77 newborns, had an intermediate reduction in mid-early change hemoglobin level distribution. 36 newborns had the least reduction.

Out of 39(21 %) whose birth weight is <2500 grams 28 newborns had the least reduction

Table 5: Birth Weight And Late Early Change In Hemoglobin Comparison

Late early change in g/dl	<2500 gms	>2500 gms	Total
Greatest reduction <1.9 g/dl	1	6	7
Intermediate reduction <-1.0->-1.9 g/dl	2	28	30
Least reduction >-1.0 g/dl	36	89	125
Total	39	123	162 (100%)
Chi- square = 6.86 , p=<0.05* , Statistically significant			

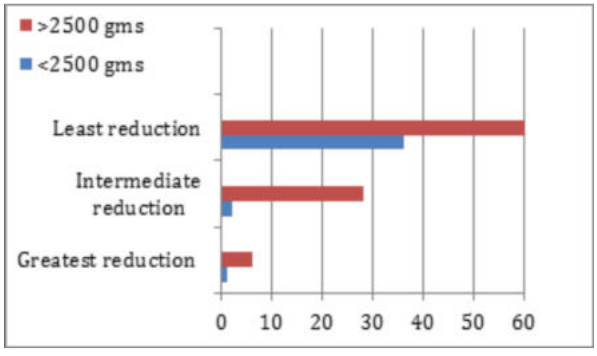

Figure 5: Birth Weight And Late Early Change In Hemoglobin Comparison

89 newborns whose birth weight is >2500 grams had the least reduction in maternal late- early change hemoglobin level. Only 36 babies who had the least reduction in late to early hemoglobin change were born with birth weight <2500 grams.

DISCUSSION:

162 pregnant women were observed during their pregnancy in three trimesters for changes in levels of hemoglobin and their effect on birth weight of their babies.

The mean maternal early hemoglobin in the present study was 10.90 ±1.38 g/dl. A majority of 51.2% had a maternal early hemoglobin between 10-12g/dl, 24.7% had Hb value between 8 to 10 g/dl. 22.2% had Hb> 12 g/dl and 1.9% had Hb less than 7.9 g/dl. Therefore 26.6% of mothers were anemic at the timeof early Hb sample acquisition.

The mean maternal mid hemoglobin level was 10.06 ±1.14 g/dl and a majority that is 51.2% had 10-12g/dl. 41.4% had maternal Hb level 8 to 10g/dl, 3.7% had more than 12 g/dl and 3.7% had less than 7.9 g/dl. Therefore 45% of mothers became anemic, i.e., value below 10 g/dl. The increase in mothers with low hemoglobin levels from 26.6% to 45% could be attributed to hemodilution.

The maternal late hemoglobin level was 11.05 ±1.37 where 37% had Hb value between 10-12g/dl and 29.6% had Hb level between 8 to 10g/dl.

Hb level > 12 g/dl in 31.5% and 1.9% had Hb level < 7.9 g/dl the present study.

The percentage of maternal hemoglobin levels below 10 g/dl increased to 31.5%. We can attribute this rise in Hb level to the plateau of plasma volume expansion.

Ramya et al[19] in their study reported that the majority of the pregnant mothers were anemic 59.4% (892).Kumar et al.[26] conducted a study in 2013, which showed more than 50% of the mothers were anemic at some point of time during pregnancy and 39% of the mothers were anemic throughout.

Distribution based on the mid-early change in hemoglobin where the majority that is 52.55% had an intermediate reduction that is <-1.0 to

>-1.9 g/dl and 39.5% had the least reduction, i.e., change Hb> -1.0 gram per deciliter and greatest reduction, i.e., <-1.9 g/dl was observed in 8%.Late -early change inhemoglobin shows 77.2% had the least reduction and 18.5% had intermediate reduction and 4.3% had the greatest reduction. Study conducted by Churchill et al.[25] indicated that the fall in hemoglobin concentration during pregnancy appears to be much greater than often described in guidelines. Jwa et al[20] found that Hb changes were significantly inversely associated with placental ratio, which may explain conflicting results from previous studies regarding anemia during pregnancy and the increased risk of high placental ratio. A statistically significant correlation was observed between birth weight and maternal early hemoglobin as the P value calculated to be less than 0.05. 51% of babies had early maternal hemoglobin levels between 10 – 12 g/dl. 23 new-borns (14%), born to mothers with early hemoglobin level of 8 to 10 g/dl were <2500grams. Statistically significant correlation was observed between maternal made hemoglobin levels and birth weight as the P value calculated to be < 0.05. Majority of newborns are concentrated in the hemoglobin range of 8 to 12 g/dl.

51.23% are in the range of 10-12 g/dl. Out of them, 75 newborns were >2500 grams and 8 are <2500 grams. Statistically significant correlation was observed between maternal late hemoglobin and birth weight as the P value calculated to be less than 0.05.

Nearly two thirds of the babies are concentrated in the 8 to 12 g/dl range maternal hemoglobin combined. Statistically significant correlation was observed between mid-early change in hemoglobin and birth weight as the P value calculated to be less than 0.05.

Out of 123 babies who had birthweight >2500 grams, the majority, i.e., 77 new-borns had an intermediate reduction in mid-early change hemoglobin level distribution. 36 new-borns with >2500 grams birth weight had the least reduction. 28 babies out of 162 that is 17.2% who had least reduction were born with low birth weight out of the total 39 low birth weight babies in the study total of 162 babies, out of 85 babies in intermediate reduction, the majority, i.e., 77 babies (47.5%) were born within normal birth weight range. A statistically significant correlation was observed between late early change in hemoglobin and birth weight as the P value calculated to be less than 0.05.

Despite with least reduction, i.e., less change in hemoglobin level from early to late trimester, 89 new-borns had birthweight >2500 grams. This could be due to less change in plasma volume in the late trimester, which is nearly constant after 26 weeks. Only 36 babies who had the least reduction in late to early hemoglobin change out of 162 that is 22.22% , were born with birth weight <2500 grams

CONCLUSION:

Failure or inadequate expansion of plasma volume from early to mid-trimester results in low-birth-weight babies in our study.

The incidence of low-birth-weight babies in late to early hemoglobin changes compared to late-early hemoglobin changes in our study is relatively lesser and statistically insignificant.

Hemoglobin changes from early to midweeks of gestation are more significant than those from early to late pregnancy.

Plasma volume expansion has effects on the birth weight . Inadequate expansion in PV leads to low birth weight

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