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Original Research Article

Assessing Correlation between New Born Size and Maternal First Trimester Hemoglobin Concentration: a Retrospective Study

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Abstract

Aim: The aim of the present study was to assess the correlation between new born size and maternal first trimester hemoglobin concentration.

Methods: The retrospective study, conducted in the Department of Obstetrics and Gynecology, AIIMS, New Delhi, India. included 200 mothers registered for antenatal care (ANC) and willing to continue till confinement were recruited after written informed consent as per routine protocol.

Results: Out of 200 women patients, 55% had normal Hb level followed by mild 32% and 13% moderate. The correlation between hemoglobin concentration and birth weight and other anthropometric parameters was measured by using chi square test and student's t-test. P-value was considered significant if it was below and highly significant in case <0.001.

Conclusion: Increased incidence of low birth weight babies is seen if the mother is anemic in her first trimester with significant association when hemoglobin is less than 8 gm%. Increased incidence of preterm deliveries is seen if the mother is anemic in her first trimester. We observed better neonatal outcome in the form of weight and anthropometry if maternal hemoglobin is in range of 10 to 13 gm%.

Keywords: new born size, maternal first trimester, haemoglobin concentration

Introduction

Women are more likely than men to have low iron stores because of blood loss at the time of menstruation. During pregnancy, the fetal demand for iron increases maternal daily iron requirements from ≈1 to 2.5 mg/d in early pregnancy and 6.5 mg/d in the third trimester. The average daily diet in the developed world contains ≈10–14 mg nonheme iron[1] but not all of this can be absorbed. Evidence from stable-isotope studies suggests that the percentage of nonheme iron absorbed from food during normal pregnancy increases from 7% at 12 wk of gestation to 36% at 24 wk and 66% at 36 wk. These dramatic changes enable the healthy pregnant woman to cope with the extra demands of pregnancy without becoming anemic [1], but only if there is adequate iron in her diet. If the woman's diet is deficient in iron, as is the case in many developing countries, fetal requirements can be met only by additional contributions of iron from maternal stores. This demand by the developing fetus may cause the mother to develop iron deficiency anemia if she had inadequate iron stores at the beginning of pregnancy.

Whether a pregnant woman is anemic cannot be assessed simply by measuring the blood hemoglobin concentration because a major factor influencing hemoglobin concentration in pregnancy is expansion of plasma volume. How this occurs is not fully established but part of the sequence might be as follows. Heat production by the fetoplacental unit causes a rise in body temperature. Heat loss is increased by peripheral vasodilatation, which causes a drop in blood pressure. This in turn stimulates the release of aldosterone from the adrenal gland, causing the retention of salts and water. [2] The drop in osmolality that occurs reduces blood viscosity and enhances blood flow in the low-pressure system of the intervillous space. Enhanced blood flow improves fetal growth. In women who are not given supplemental iron, the hemoglobin concentration of the maternal blood falls from an average of ≈133 g/L in nonpregnant women to an average of ≈110 g/L at 36 wk of gestation. [3] The fall is steepest up to 20 wk of gestation; the hemoglobin concentration remains fairly constant up to 30 wk and then rises slightly thereafter. [4,5] These changes in hemoglobin concentration are due mainly to changes in plasma volume; the red cell mass and total hemoglobin actually increase during pregnancy.

Maternal nutrition during pregnancy critically determines fetal nutrition and has a significant contribution to fetal and neonatal health. Maternal intakes of micronutrients such as folic acid and iron are crucial for fetal growth and development. [6] Hemoglobin concentration is a key indicator reflecting the maternal nutrition status during pregnancy, especially the iron status. [7] Previous studies reported that maternal hemoglobin concentration was associated with neonatal birth weight as well as LBW and SGA, but there is no consistent conclusion. Rasmussen et al. found a strong independent inverse correlation between the lowest second-trimester hemoglobin and birth weight, but no relationship was observed in the first trimester. [8] Haider et al. reported that neonatal birth weight increased by 14 g for every 1 g/L increase in average hemoglobin in the third trimester. Steer et al. observed that the maximum mean birth weight was achieved with a lowest hemoglobin concentration in pregnancy of 85–95 g/L, which indicated a nonlinear relationship between maternal hemoglobin during pregnancy and birth weight. [9] A recent meta-analysis revealed a U-shaped curve association between maternal hemoglobin concentration and adverse birth outcomes, which suggested that both low and high hemoglobin concentrations might be risk factors for fetal growth. [10]

The aim of the present study was to assess the correlation between new born size and maternal first trimester haemoglobin concentration.

Materials and Methods

The prospective observational study, conducted in the Department of Obstetrics and Gynecology, AIIMS, New Delhi, India for two years included 200 mothers registered for antenatal care (ANC) and willing to continue till confinement were recruited after written informed consent as per routine protocol. In this study, cases with hemoglobin >11 gm% and <11 gm% were classified as normal and anemia respectively in first trimester of pregnancy.

Inclusion Criteria

1. All pregnant women registered to our institute for ANC till deliveries were included in the Study.

2. Cases of all types of anemia including hemolytic anemia.

3. Singleton pregnancy

4. Having had a USG in first trimester to accurately confirm / adjust dates and assign gestational age accordingly

Exclusion criteria

Pregnant women with one of the following at booking were excluded:

1. Diabetes mellitus.

2. Hypertension (including pregnancy-induced hypertension).

Observation and results

3. Toxoplasmosis, Rubella, Cytomegalovirus, Herpes infection.

4. Diagnosed renal or cardiac illness.

5. Smoker or alcoholic.

6. Multiple gestation.

The investigations done were

1. Blood-
a) Measurement of hemoglobin concentration was done by cyanmethemoglobin method (Analyzer–Coulter).
b) Complete blood picture- MCV, MCH, MCHC, RDW.
c) Hematocrit (Hct).
d) Peripheral smear for typing of anemia.
e) Hemoglobin electrophoresis whenever required.
Birth weight was recorded in grams using a digital scale with a scale of 1 gram. As per weight of newborns categorization was done as normal if birth weight is above 2.5 kg and low birth weight if less than 2.5 kg.

Statistical Analysis

The correlation between hemoglobin concentration and birth weight and other anthropometric parameters was measured by using chi test and students-t test. P value was considered significant if it was below 0.05 and highly significant in case <0.001.

Results

Table 1: Percentage of severity of anemia in our study as per severity assessment by WHO classification

Hemoglobin level	First Trimester
Normal (>11.1 gm%)	110 (55%)
Mild (9.1-11 gm%)	64 (32%)
Moderate (7.1-9 gm%)	26 (13%)
Severe (4.1-7 gm%)	0
Total	200 (100%)

Out of 200 women patients, 55% had normal Hb level followed by mild 32% and 13% moderate.

Table 2: First trimester hemoglobin concentration and outcome in the form of birth weight of baby and maturity

Hb%	7.1-9.0 gm%	9.1-11 gm%	11.1-13 gm%	>13 gm%
 Mean birth weight in gm	8.16±0.46 2242±124.36	11.13±0.17 2782±398.56	11.84±0.52 2864±372.54	13.57±0.74 2656±214.16
Birth wt <2500 gms (n=60)	2018±106	2216±144	2282±102.56	2272±2098.52
Birth wt >2500 g (n=140)	3144±1.04	2945±190	2965±276.84	2754.01±152.42
Preterm(n=45)	7	19	15	4
Term(n=155)	10	60	75	10

The correlation between hemoglobin concentration and birth weight and other anthropometric parameters was measured by using chi square test and student's t-test. P-value was considered significant if it was below and highly significant in case <0.001.

Discussion

Every Second women is anemic (55%).Evidence from stable-isotope studies suggest that the percentage of non-heme iron absorbed from food during normal pregnancy increases from 7% at 12 weeks of gestation to 36% at 24 weeks and 66% at 36 wks. These dramatic changes enable the healthy pregnant woman to cope with the extra demands of pregnancy without becoming anemic1, but only if there is adequate iron in her diet. [11] Prevalence of anemia in South Asian countries is the highest in the world. WHO estimates that even among the South Asian countries, India has the highest prevalence of anemia. [12] NNMB (National Nutrition Monitoring Bureau), DLHS (District Level Household Survey) and ICMR (Indian Council of Medical Research) surveys showed that over 87% of pregnant women suffer from anemia and about 10% have severe anemia. The importance of adequate plasma volume expansion in allowing adequate fetal growth is attested by several studies that showed an increased incidence of low birth weight in association with either a high maternal hemoglobin concentration [13-15] or high hematocrit. [16]

Out of 200 women patients, 55% had normal Hb level followed by mild 32% and 13% moderate. Neonatal birth weight has been obtaining wide attention as it is a strong predictor of neonatal and perinatal mortality and disability, as well as birth weight percentiles, are used to predict the risk of growth disorders in newborns. [17] The global prevalence of low birth weight (LBW) was 14.6% in 2015 [18] and it was estimated that approximately 32.4 million infants that were small for gestational age (SGA) were born in low-income and middle-income countries in 2010. [19] Both LBW and SGA were associated with short-term and long-term adverse outcomes, such as infection, respiratory depression, jaundice, obesity, insulin resistance and type 2 diabetes. [20,21] In addition, the prevalence of large for gestational age (LGA) and macrosomia is also increasing, especially in developing countries. [22,23] The correlation between hemoglobin concentration and birth weight and other anthropometric parameters was measured by using chi square test and student's t-test. P-value was considered significant if it was below and highly significant in case <0.001.

Maternal Hb concentration in the late-third trimester had a roughly negative association with neonatal birth weight and a faint U-shaped association with Lightweight. When maternal Hb was 100–110 g/L, the risk of Lightweight was the lowest and the risk of Heavyweight was relatively high. Similar to our results, Chen et al. showed that maternal Hb in the third trimester was inversely correlated with neonatal birth weight. [24] Relatively low maternal Hb in the third trimester usually reflects changes in plasma volume rather than poor maternal nutrition or adaptation. [25] However, a recent prospective study from Northwest China showed an inverted U-shaped association between maternal Hb in the third trimester and neonatal birth weight [26] and a significant positive correlation between maternal Hb in the third trimester and birth weight was reported in another study. [27]

In several studies, a U-shaped association was observed between maternal hemoglobin concentrations and birth weight. Abnormally high hemoglobin concentrations usually indicate poor plasma volume expansion, which is also a risk for low birth weight. Lower birth weights in anaemic women have been reported in several studies. [28,29] In our study, in first trimester clustering of normal birth weight was observed in hemoglobin (Hb) range of 9.0 to 13.0gm% and percentage of LBW was increased as hemoglobin drops below 9.0 gm% and also when hemoglobin is above 14 gm%. We also observed, high hemoglobin percentage above 14 gm% was not positively associated with proportionate increase in newborn size as noted with U shape correlation of maternal hemoglobin with newborn size and gestational age.

Conclusion

Increased incidence of low birth weight babies is seen if the mother is anemic in her first trimester with significant association when hemoglobin is less than 8 gm%. Increased incidence of preterm deliveries is seen if the mother is anemic in her first trimester. We observed better neonatal outcome in the form of weight and anthropometry if maternal hemoglobin is in range of 10 to 13 gm%. Supplementing iron earlier during antenatal period and maintaining optimal hemoglobin concentration between 10 to 13 gm percent has overall better outcome regarding premature deliveries and low birth weight babies. Regular antenatal care from first trimester has a vital role in assessing and managing maternal anemia timely and it directly affects the perinatal outcome.

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