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Original Research Article

Correlation of maternal hemoglobin with outcome of neonatal gestational age and birth weight

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ABSTRACT

Background: Anemia is the most common nutritional deficiency disorder in the world. Maternal anemia has become one of the major health concerns worldwide. It is associated with adverse maternal and fetal outcomes such as increased rates of maternal and perinatal mortality, premature delivery, low birth weight and certain anomalies. This study was done to find out the correlation between maternal hemoglobin and birth weight and gestational age of newborn at birth.
Methods: This is an observational clinical study, which included 1501 pregnant mother and their newborn babies. All singleton live born babies born were examined. The pregnant women's lowest recorded hemoglobin measurement during pregnancy is correlated with outcomes of neonatal gestational age and birth weight.
Results: Majority of the mothers belonged to lower middle class. 59.4% of the mothers were anemic. 21% of the babies born were preterm and 30% of the babies born were low birth weight.
Conclusions: In India, according to WHO 2018 data, anemia in pregnancy is 65-75%. Present study outcome shows, preterm deliveries is 12.1% and low birth weight is 17.8% born to anaemic mothers who were 59.4%. The reduction in percentage of anaemic mothers in current study is due to National health programmes. In future, these programs will help to reduce the incidence of anaemia in pregnancy, which in turn will reduce low birth weight and preterm deliveries.

Keywords: Hemoglobin, Low birth weight, Preterm

INTRODUCTION

Anemia is the most common nutritional deficiency disorder in the world. Maternal anemia has become one of the major health concerns worldwide. It is associated with adverse maternal and fetal outcomes such as increased rates of maternal and perinatal mortality, premature delivery, low birth weight and certain anomalies.

Anaemia is a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs, which vary by age, sex, altitude, smoking, and pregnancy status.[1] According to WHO, hemoglobin level below 11 gm/dl in pregnant women constitutes anemia and hemoglobin below 7 gm/dl is severe anemia.[2]

Globally, anemia affects 1.62 billion people, which corresponds to 24.8% of the population. However, the population group with the greatest number of individuals affected is pregnant women (41.8%).[3] WHO has estimated that prevalence of anemia in developed and developing countries in pregnant women is 14 percent in developed and 51 per cent in developing countries and 65-75 percent in India alone.[4]

Globally the overall prevalence for low birth weight infants due to Iron deficiency anemia is 15.5% - 20%, in which the levels are found to be higher in developing countries by 16.5%, especially Asia.[5] According to National Family Health Survey (NFHS)-(III) more than half of women in India (55%) have anemia, including 39% with mild anemia, 15% with moderate anemia and 2% with severe anemia.[6]

In India 26 million newborn infants are born every year. The current NMR 2016 is 24per 1000 live births and the current IMR 2012 is 34 per 1000 live births in India. One of the most important causes of NMR is low birth weight and prematurity.[7] Surveys in different parts of India indicate that about 50%-60% of women belonging to low socioeconomic group are anemic during pregnancy. The major etiological factors being iron and folic acid deficiencies. It is well known that anemia per se is associated with high incidence of premature birth and low birth weight.[8]

Current knowledge indicates that iron deficiency anemia in pregnancy is a risk factor for preterm delivery and subsequent low birth weight, and possibly for inferior neonatal health. Some studies have shown a strong association between low hemoglobin before delivery and adverse out come while other studies have not found a significant association.[9,10] The present study of comparison of the maternal hemoglobin, gestational age and birth weight will help in early prediction, prevention, early intervention of risk and complications of low maternal hemoglobin and its effect on gestational age and birth weight. Thus, the aim of this study was to evaluate the antenatal maternal hemoglobin and find its impact on perinatal outcome.

METHODS

This study was conducted in Kempegowda Institute of Medical sciences for a period of eighteen months between December 2016 to June 2018. 1501 singleton live born babies in Kempegowda Institute of Medical Sciences Hospital were included in the study. An observational clinical study which included 1501 pregnant mother and their newborn babies. Descriptive and inferential statistical analysis has been carried out in the present study. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

Inclusion criteria

Mother

- All pregnant women with singleton pregnancy of age >18 years and <45 years.

Newborn

- All singleton live born babies born in Kempegowda Institute of Medical Sciences and Research Center, Bangalore.

Exclusion criteria

Mother

- Systemic illnesses like Diabetes mellitus and Hypertension (including pregnancy induced diabetes mellitus and pregnancy induced hypertension). Renal and Cardiac diseases.
- Pregnant Women on any drugs affecting fetal growth.
- Antenatal Infection with Toxoplasmosis, Rubella, Cytomegalo Virus, Herpes Virus.
- Smoker and alcoholic.

Newborn

- All twin babies.
- Intrauterine deaths and still born babies.
- Babies with gross congenital anomalies

Method of collection of data

All singleton live born babies born in Kempegowda Institute of Medical Sciences and Research Center Bangalore were examined. Birth weight was recorded in kilograms using a digital scale. The pregnant women's lowest recorded hemoglobin measurement during pregnancy is correlated with outcomes of neonatal gestational age and birth weight.

Low birth weight defined as weight less than 2500 grams and preterm delivery defined as less than 37 weeks of gestational age. Written informed consent was taken from the parents before enrolling the mother and the baby into the study. Antenatal history of the mother was taken in the proforma and hemoglobin levels of first, second and third trimester were recorded and later the lowest hemoglobin level of the three trimesters is taken as a separate entity and this hemoglobin is compared with the new born weight, which is immediately measured after birth. Gestational age of the baby is noted down through the last menstrual date of the mother and ultrasonography date also noted down through the antenatal record and now the gestational age of the baby is confirmed by examining the baby using the Ballard scoring scale. Now the collected data is registered in to the master chart and later analysed statistically.

Statistical analysis

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in

Number (%). Significance is assessed at 5% level of significance.

Assumptions

- Dependent variables should be normally distributed,
- Samples drawn from the population should be random, Cases of the samples should be independent.

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis. Fisher Exact test used when cell samples are very small.

Significant figures

- + Suggestive significance (P value: 0.05<P<0.10)
- * Moderately significant (P value:0.01 <P ≤ 0.05)
- ** Strongly significant (P value: P≤0.01)

Statistical software

The Statistical software namely SPSS 18.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS

Descriptive and inferential statistical analysis has been carried out in the present study. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

The study was conducted on 1501 pregnant women and the results obtained were as follows.

Table 1: Age distribution of patients studied.

Age in years	No. of patients	%
<20	74	4.9
20-30	1260	83.9
31-40	164	10.9
41-50	3	0.2
Total	1501	100.0

Among the study group, 83.9% (1260) were in age group of 20-30 years, 10.9% (164) were in the age group of 31-40 years, 4.9% (74) were in the age group less 20 years, and 0.2% (3) were above age group 40 years (Table 1). In present study 23% (341) belongs to rural area, and 77% (1160) belongs to urban area. There is significant difference in the frequencies of rural and urban areas.

Table 2: Socio economic status distribution of patients studied.

Socio economic status	No. of patients	%
Lower	145	9.7
Lower middle	1157	77.1
Upper	9	0.6
Upper lower	129	8.6
Upper middle	61	4.1
Total	1501	100.0

Table 3: Comparison of birthweight distribution according to levels of hemoglobin of cohort studied.

variables	No. of patients	Hemoglobin (g/dl)				P value
		<7	7-10	10-11	>11	
Birth weight (kg)						
<1000	3	0 (0%)	0 (0%)	1 (33.3%)	2 (66.7%)	0.630
1001-1500	41	0 (0%)	11 (26.8%)	10 (24.4%)	20 (48.8%)	
1500-2500	409	3 (0.7%)	103 (25.2%)	140 (34.2%)	163 (39.9%)	
2500-3500	947	8 (0.8%)	227 (24%)	338 (35.7%)	374 (39.5%)	
>3500	101	2 (2%)	20 (19.8%)	29 (28.7%)	50 (49.5%)	

Table 4: Incidence of preterm babies among mothers with different severity of anemia.

Lowest Hemoglobin (g/dl)	Severity of anemia	Gestational age		Total
		P	T	
<7	Severe	3 (1%)	10 (0.8%)	13 (0.9%)
7-10	Moderate	88 (27.9%)	330 (27.8%)	418 (27.8%)
10-11	Mild	92 (29.2%)	369 (31.1%)	461 (30.7%)
>11	No anemia	132 (41.9%)	477 (40.2%)	609 (40.6%)
Total		315 (100%)	1186 (100%)	1501 (100%)

Table 5: Birth weight (kg) distribution in relation to levels of hemoglobin.

Birth weight (kg)	Hemoglobin (g/dl)				Total
	<7	7-10	10-11	>11	
<2500	3 (23.1%)	88 (24.4%)	121 (23.4%)	146 (24%)	358 (23.9%)
≥2500	10 (76.9%)	273 (75.6%)	397 (76.6%)	463 (76%)	1143 (76.1%)
Total	13 (100%)	361 (100%)	518 (100%)	609 (100%)	1501 (100%)

Table 6: Gestational age and severity of anemia.

Gestational Age	Hemoglobin (g/dl)				Total
	<7	7-10	10-11	>11	
Preterm	3 (23.1%)	76 (21.1%)	104 (20.1%)	132 (21.7%)	315 (21%)
Term	10 (76.9%)	285 (78.9%)	414 (79.9%)	477 (78.3%)	1186 (79%)
Total	13 (100%)	361 (100%)	518 (100%)	609 (100%)	1501 (100%)

P=0.926, Not Significant, Chi-Square Test

Total 9.7% (145) belonged to lower socioeconomic class, 8.6% (129) belonged upper lower class, 77.1% (1157) belonged lower middle class, 4.1% (61) belonged to upper middle class, 0.6% (9) belonged to upper class. Majority of the studied population in our group belonged to lower middle class (Table 2). Among the study group, out of 1501 babies delivered in our hospital, 44.8% (672) babies were female and 55.2% (829) were male babies.

Total 30.1% (453) of the babies were low birth weight babies, and 69.1% (1048) were normal weight babies. Most of the babies born were between the range of 2500-3500 grams. 41 babies (2.7%) were very low birth weight babies, and 3 babies (0.2%) were extremely low birth weight babies (Table 3).

In present study majority of the pregnant mothers were anemic 59.4% (892), out of which, 34.5% (518) were mild anemic (hemoglobin 10-11g/dl), 24.1% (361) were moderately anemic (hemoglobin 7-10 g/dl), 0.9% (13) were severely anemic (hemoglobin <7 g/dl).

In present study 59.4% (892) were anemic with hemoglobin <11 g/dl, and 40.6% (609) were non anemic mothers with hemoglobin >11 g/dl. This study shows that majority of the mothers were anemic during pregnancy.

DISCUSSION

Anemia is quite prevalent among women in developing countries, especially during the child bearing age. Kumar et al, 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.[11] In the present study the percentage of pregnant women with hemoglobin level <11 gm/dl was 59.5%. Two large studies in the industrial world, involving over one million pregnancies clearly indicated that favorable pregnancy outcomes are less frequent among anemic mothers.[12,13]

The causality of anemia in these undesirable pregnancy outcomes has been established further by studies that show the positive results obtained in births weights and perinatal deaths by the successful treatment of anemia with iron and folic acid as low birth weight (<2000 g) was reduced from 50% to 7% and perinatal mortality from 38% to 4% in a study in Nigeria.[14]

This study was done to compare maternal hemoglobin with birth weight and gestational age of the newborn. Present study included 1501 mothers and their newborn, delivered at KIMS hospital, Bangalore. As the present study was conducted in urban area, at the heart of the Bangalore city, majority of the population is urban (77.3%) as compared to rural population (22.7%) are significant.

In the present study, 892 (59.4%) mothers had hemoglobin levels less than 11 gm/dl and 609 (40.6%) had hemoglobin levels >11 gm/dl during pregnancy. It shows that majority of the mothers were anemic during pregnancy, which are similar to national statistics and other studies.[4] Majority of the mothers had mild anemia which may be explained on the basis of relatively low hemoglobin concentration during pregnancy mainly because of plasma volume expansion.[15]

In the present study, 30.1% were low birth weight babies in both anemic and non anemic mothers, and 21% were preterm deliveries for both anemic and non anemic mothers. This may be noted that anemia in pregnancy may occur as a result of physiological anemia of pregnancy, where there is increase in plasma volume greater than red cell concentration.

Low hemoglobin or hematocrit may be an early marker. Other risk factor for preterm and low birth weight babies are stress, multiple pregnancies, premature rupture of membranes, abruption placenta, placentaprevia. Also, low hematocrit could lead to oxygen delivery to fetus.[16]

Non anemic mothers in present study also had low birth weight babies which may be due to multiple pregnancies, obstetric causes like abruption placenta, placenta previa, and premature rupture of membranes. Abnormally high hemoglobin concentrations usually indicate poor plasma volume expansion, which is also a risk for low birthweight.[17,18]

Thus, authors conclude that anemia is the major contributing factor for prematurity and low birth weight. As majority of the pregnant mothers were anemic and other risk factors like abruptioplacenta, placenta previa, and premature rupture of membranes should be treated to prevent preterm and low birth weight babies. More researches should be conducted to include factors outside medical field such as social support, stress and other life style elements. All of these factors should be tested in order to identify and confirm the population at risk and thus improve antenatal management.

CONCLUSION

An observational clinical study consisting of 1501 mothers and their newborns delivered at KIMS hospital from December 2016 to June 2018, was studied to correlate the maternal hemoglobin with birth weight and gestational age of newborn. In India, according to WHO 2018 data, anemia in pregnancy is 65-75%. Present study outcome shows, preterm deliveries is 12.1% and low birth weight is 17.8% born to anemic mothers who were 59.4%. The reduction in percentage of anemic mothers in our study is due to National health programmes regarding safe pregnancy like Mother and Child Health programmes (MCH) and Reproductive Maternal Newborn Child and Adolescent Health programme (RMNCHA). In future, these programs will help to reduce the incidence of anaemia in pregnancy, which in turn will reduce low birth weight and preterm deliveries. By these programmes, we can surely achieve the goal by reduction of anemia to 50% in pregnant women by 2030.

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