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Original Research Article

Maternal anaemia and neonatal outcome: An observational study on rural pregnant women

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ABSTRACT

Background and Objective: Anaemia in pregnancy is a public health problem in developing countries. An observational study of anaemic pregnant women was carried out at the Department of Obstetrics and Gynecology from 1st December 2015 to 30th may 2017, to determine the effects of maternal anaemia on the newborn babies according to the severity of anaemia.
Materials and Methods: 314 pregnant women with anaemia were included in this study. Parameters studied were haemoglobin levels, neonatal birth weight, APGAR score, NICU admission and cord blood haemoglobin. Severity of anaemia is determined by additional cutoffs, with severe anaemia defined as a haemoglobin level of less than 7.0g/dl.
Statistical analysis: Statistics 16.0 software was used.
Results: Out of 314 patients, 24 patients (7.6%), 39 patients (12.4%), 251 patients(79.9%) were in severe, moderate, and mild category respectively. Mean haemoglobin levels in present study was 8.65gm/dl. 219 newborns (69.7%) were low birth weight out of which 100% babies born to severely anaemic mothers were LBW which shows that with increase in severity of anaemia, birth weight decreases which is statistically significant. 91.7% babies born to severe category had less than 7 APGAR score. 91.7% newborn in severe anaemia were admitted to NICU. 87.5% babies born to severely anaemic women had neonatal anaemia.
Conclusion: Anaemia during pregnancy and its management remains an important issue in perinatal medication. Correct diagnosis and treatment lead to effective management of fetal and maternal risks and improved perinatal outcome.

1. Introduction

Anaemia of pregnancy is a global public health challenge affecting two billion of the world's population, predominant among the vulnerable population such as infancy, childhood and in women of reproductive age group.[1] The burden falls predominantly on Asia and Africa with the complex interplay of dietary factors, infectious disease, genetics and other factors determining anaemia status.[2] According to WHO, 14% of pregnant women in developed countries, 56% in developing countries and 65-75% in India are anaemic. Also more than 40% of non-pregnant and over 50% of pregnant women in developing countries are affected.[3]

During pregnancy anaemia is common due to increased demand of iron for the growing fetus and placenta and increased red blood cell mass, which is further aggravated with other factors such as childbearing at an early age, repeated pregnancies, short intervals between pregnancies, and poor access to antenatal care and supplementation. The consequences of iron deficiency anaemia during gestation includes preterm delivery, low birth weight, and

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perinatal mortality. Reduced level of haemoglobin favour changes in placental angiogenic. Thereby causing decreased availability of oxygen which results in intrauterine growth restriction and low birth weight.

Infants with anaemia have higher prevalence of failure to thrive, poorer intellectual developmental milestones, and higher rates of morbidity and neonatal mortalities than infants without anaemia.[4] A strong relationship was found between maternal anaemia and low birth weight babies. Across the world, neonatal mortality is 20 times more likely for low birth weight babies as compared to heavier babies.[5] It is also established as an important risk factor for neonatal morbidity.[6,7] Adverse perinatal outcome in the form of preterm and small for gestational age babies and increased perinatal mortality rates have been observed in the neonates of anaemic mothers.[8]

2. Materials and Methods

The study was conducted in Department of Obstetrics and Gynecology of R.D.Gardi Medical College, Surasa, Ujjain, a tertiary care hospital in rural area from December 2015 to may 2017. 314 anaemic pregnant women were included in this study.

2.1. Inclusion criteria

All pregnant women with haemoglobin level of less than 11 gm/dl coming in labour at term gestation.

2.2. Exclusion criteria

Women with obstetric complications like malpresentation, antepartum haemorrhage, hypertensive disorders of pregnancy, early pregnancy haemorrhage, and women with medical disorders like diabetes mellitus, hypothyroidism, chronic kidney disease, and heart disease.

All mothers and babies who satisfied the inclusion criteria were included in the study. Anaemic mothers were classified according to WHO classification into mild (haemoglobin 9.0-10.9 g/dl), moderate (haemoglobin 7.0-8.9 g/dl), and severe (haemoglobin less than 7.0 g/dl) category.

All babies were personally examined for birth weight, APGAR score of <7 at 5 min, NICU admission and neonatal anaemia (haemoglobin <14 gm/dl). All data collected were entered in Microsoft Excel and statistics 16.0 software was used for statistical analysis. For comparison of quantitative variables, one way ANOVA test and linear regression was applied and for qualitative measures chi-square test and logistic regression was applied.

3. Results

A total of 314 anaemic mothers and babies were included in the study. Majority of women that is 251 patients (79.9%) were in moderate category of anaemia, 39 patients (12.4%) in mild category and only 24 patients (7.6%) in severe category as shown in Table 1.

Table 1: Distribution of women according to degree of anaemia

Degree of anemia	No. of cases	Percentage (%)
Mild	39	12.4
Moderate	251	79.9
Severe	24	7.6
Total	314	100.0

219 (69.7%) newborns were low birth weight out of total of 314. 76 (24.2%) newborns had low APGAR score at 5 min and 86 (27.4%) newborns had neonatal anaemia. 80 (25.5%) newborns were admitted to NICU Table 2.

In mild category (9-10.9), total 39 babies were born. Out of which, 2 babies were only low birth weight and 37 were normal weight babies whereas in moderate and severe categories 251 and 24 babies were born respectively. Out of 251, 76.9% babies were low birth weight and 23.1% (58) were normal weight whereas in severe category all 100% (24) were low birth weight. No baby was normal weight in severe category. So this proves that with increase in severity of anaemia, the birth weight decreases which is statistically significant (p=0.000) as shown in Table 3.

There is linear relationship between haemoglobin of mother and birth weight of neonate as shown in Figure 1.

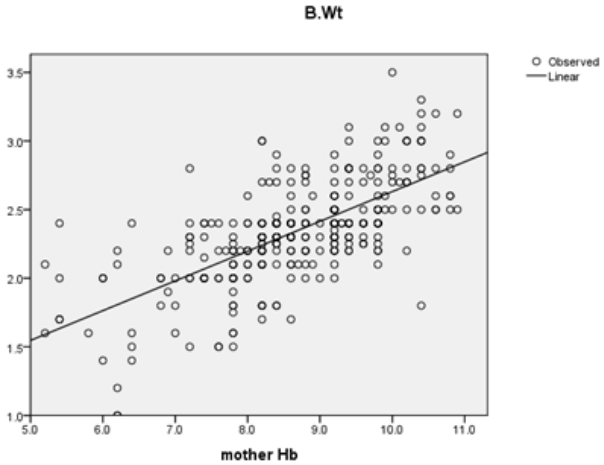

Fig. 1: Linear regression curve between maternal haemoglobin and birth weight of baby

Linear regression equation is given by y=a+bx where y= cord hemoglobin, x=mother hemoglobin,

a= 0.462, b= 0.217, y=0.462+0.217x, R2=0.449 p=0.000

Out of total 314 anaemic mothers, 76 babies had APGAR score of less than or equal to 7. 91.7% babies in severe category had APGAR score of less than or equal to 7 whereas only 21% in moderate category and

Table 2: The distribution of neonatal parameters among study population

	Parameters	Number of cases (total=314)	Percentage (%)
1	Low Birth weight		
	<2.5kgs	219	69.7
	>=2.5 kgs	95	30.3
2	APGAR score at 5 min		
	<=7	76	24.2
	>7	238	75.8
3	NICU admission		
	Yes	80	25.5
	No	234	74.5
4	Cord hemoglobin		
	<14	86	27.4
	>=14	228	72.6

Table 3: The relation of maternal anaemia with neonatal parameters

S.No	Parameters	Mild	Moderate	Severe	Total	Chi square	P value
1	Birth weight						
	<2.5 kgs	2(5.1%)	193(76.9%)	24(100%)	219(69.7%)	93.65	<0.001
	>=2.5	37(94.9)	58(23.1%)	0(0%)	95(30.3%)		
2	APGAR score at 5 min						
	<7	1(2.6%)	53(21.1%)	22(91.7%)	76(24.2%)	70.80	<0.001
	>=7	38(97.4%)	198(78.9%)	2(8.3%)	238(75.8%)		
3	NICU admission						
	Yes	1(2.6%)	57(22.7%)	22(91.7%)	80(25.5%)	67.16	<0.001
	No	38(97.4%)	194(77.3%)	2(8.3%)	234(74.5%)		
4	Cord hemoglobin						
	<14	1(2.6%)	64(25.5%)	21(87.5%)	86(27.4%)	56.143	<0.001
	>=14	38(97.4%)	187(74.5%)	3(12.5%)	228(72.6%)		

2.6% in mild category had poor APGAR score. As the severity of maternal anaemia increases, the possibility of having low APGAR score also increases. There is statistical significance between severity of anaemia and APGAR score at 5 min, the value is 0.000 shown in Table 3.

91.7% newborns in severe anaemia were admitted to NICU whereas only 2.6% and 22.7% newborns were admitted to NICU in mild and moderate anaemia respectively. As the severity of anaemia increases, NICU admission also increases which is statistically significant. 87.5% mothers with severe anaemia had neonatal anaemia whereas 25.5% with moderate anaemia and only 2.6% with mild anaemia had neonatal anaemia, respectively as shown in Table 3.

There is direct relationship between maternal hemoglobin and birth weight of the babies i.e. mean birth weight increased from 1.78 kgs at hemoglobin level <7 gm/dl to 2.78 kgs at hemoglobin level 9-10.9 gm/dl. Similarly, mean cord blood hb also increased from 12.9 gm/dl at hemoglobin value <7gm to 16.7 gm/dl at 9-10.9 gm.

Also APGAR score at 5 min shows similar results. It was increased from 5 at <7 gm to 9.3 at 9-10.9 gm. (Table 4)

The risk of low birth weight increases by 65.6 times higher in anaemic pregnant women with increase in severity of anaemia (95% CI=15.5-277.6). There was 29.4 times risk of poor APGAR score at 5 min (95% CI=8.7-98.6) and 27.6 times (95% CI= 8.2-91.9) increased risk of NICU admission among anaemic pregnant women. The risk of neonatal anaemia increased by 18 times (95% CI= 6.4-52.5) with increase in severity of anaemia as shown in Table 5.

Thus proving that maternal anaemia has direct effect on birth weight, APGAR score, NICU admission and cord blood haemoglobin.

4. Discussion

Anaemia is one of the most prevalent nutritional deficiency problems affecting pregnant women. According to Dallman(1987),[9] anaemia alters immunity, increases maternal and fetal stress, and it alters the transfer of oxygen from hemoglobin to fetus through placenta. 7.3 million perinatal deaths occur annually in the world,[10] and by correcting anaemia many of these deaths can be prevented. Since, the demand for micronutrients is maximum in third trimester and majority of women present for antenatal care in third trimester which could be one of the reasons for high

Table 4: One way ANOVA table forbirth weight, cord hemoglobin and Apgar score at 5 min according to severity of maternal anaemia

		N	Mean	Std. Deviation	P value
B.Wt	9-10.9	39	2.785	.3165	0.000
	7-8.9	251	2.323	.2951	
	<7	24	1.783	.3964	
	Total	314	2.339	.3767	
cord Hb	9-10.9	39	16.708	1.6192	0.000
	7-8.9	251	15.379	1.7949	
	<7	24	12.946	1.3449	0.000
	Total	314	15.358	1.9230	
Apgar at 5min	9-10.9	39	9.31	.766	
	7-8.9	251	8.09	1.012	
	<7	24	5.04	2.726	
	Total	314	8.01	1.525	

Table 5: Neonatal risk factors significantly associated with increase in severity of maternal anaemia

Variables	P value	Odd's ratio	95% CI of OR
Low Birth weight	0.000	65.616	15.508 - 277.638
Apgar score at 5 min <7	0.000	29.365	8.748 - 98.569
NICU admission	0.000	27.557	8.255 - 91.989
Neonatal anemia	0.000	18.279	6.366 - 52.486

prevalence of anaemia.[11,12]

In present study, 219 mothers (69.7%) delivered low birth weight babies i.e. <2.5 kgs approx. similar to Ahmad et al (64%),[13] Dalal et al (73.24%)[14] and Mandve et al. (60.3%).[15] Mean birth weight was observed to be 2.339kgs, with a standard deviation of +/- 0.3767 which was similar to study by Sangeeta VB et al[16] in which mean hemoglobin was 2321.80 g +/- 531.06.

Current study had shown that, 5% of the babies born to mildly anemic, 76.9% babies were born to moderately anemic mothers, and all the babies born to women with severe anaemia had birth weight of less than 2.5 kgs. Low birth weight was found in women with severe and moderate anaemia whereas mild anaemia is not associated with low birth weight in current study whereas in study done by Dr. Nadir Mudher Al-Hilli (2010),[17] low birth weights were found only in women with severe anaemia while it was within normal range in women with mild and moderate anaemia. Similar results were found in the study by Singla et al (2008)[18] who stated that the birth weight was significantly reduced in the severely anemic mother and had direct relationship with the maternal hemoglobin levels.

Nair M et al., concluded that mothers with anaemia at any time during pregnancy was found to have 4.3 times higher risk of giving birth to low birth weight babies compared to non anaemic mothers.[19] In study by AjnappaB et al (2008),[20] 21% in anaemic group had birth weight <2.5kg. The risk of low birth weight was 3.6 times higher among anaemic mothers. Godfrey et al.[21] also suggested a relationship between maternal haemoglobin and low birth weight. Rana et al.[22] showed 6.8 times higher risk of LBW babies among anaemic mothers. Ahmad et al.,[13] Bakhtiar et al.,[23] Lone FW et al.[24] showed 1.8, 1.8 and 1.9 times higher risk of low birth weight babies among anaemic mothers. All these studies along with the results of present study on low birth weight showed that there is linear relationship between birth weight and grades of anaemia i.e. chances of low birth weight increases with decrease in maternal hemoglobin or increase in severity of maternal anaemia.

4.1. APGAR score at 5 min

In current study, low APGAR score at 5 min was seen in 76 (24.2%) patients. In study by Sangeeta VB et al,[16] 11% patients had poor APGAR score at birth. It also showed that the risk of an APGAR score <5 at 1 min was 1.8 times (95% CI =1.2-2.2)for anemic women. 91.7% in severe anaemia, 21.1% in moderate and only 2.6% in mild anaemia had low APGAR score. Patient with severe anaemia had poor APGAR score as compared to women with mild anaemia. Mean APGAR score in severe anaemia was 5 whereas it was increased to 9.13 in mild anaemia. Biswas et al study had shown that, about 40% of the babies born to pregnant women with mild anaemia, 12.82% babies born to pregnant women with moderate anaemia, 50% babies of severely anemic mothers and 50% babies of very severely anemic were born with APGAR score of less than 5.

4.2. NICU admission

The most common indication for NICU admission being, respiratory distress due to low APGAR scores. The total number of NICU admissions in present study was 80

(25.5%) as compared to Dalal et al (2014)[25] and Kheir et at (2016)[26] in which NICU admission was 33.03% and 15.8% respectively. 91.7% of neonates born to severely anaemic women were admitted to NICU. There is significant association of NICU admission with increase in severity of anaemia. There is 28 times (95% of CI=8.255 - 91.989) increased risk of NICU admission with increase in severity of anaemia in present study shown in Table 5. According to various studies, risk of preterm birth was 1.7 times and 4 times higher among cases with a statistically significant association, Sangeeta VB et al (2014)[16] and Farah Wali Lone et al (2004),[24] respectively.

4.3. Cord blood hemoglobin

In present study, 86 (27.4%)newborns had neonatal anaemia with mean cord hemoglobin of 15.4 gm/dl. 87.5% severely anemic, 25.5% moderately anaemia and only 2.6% mildly anaemia women gave birth to newborns with neonatal anaemia i.e. cord blood hemoglobin<14 gm/dl. In study by Arti Sareen et al.[25] (2013), mean cord blood hemoglobin was 15.09 gm/dl similar to our study. Mothers who had more severe anaemia had babies with lower cord hemoglobin. Previous studies have shown that there is a direct relationship between maternal and fetal haemoglobin[17,18] and the cord haemoglobin is lower in anaemic mothers and that the decrease appears to be proportional to the degree of anaemia, suggesting that placental iron transport mechanisms may not work at higher degrees of maternal anaemia thus leading to a fall in cord haemoglobin.

5. Conclusion

Anaemia in pregnancy definitely has a very poor outcome on the newborn with increase in severity of anaemia in terms of low birth weight, poor APGAR score, and increase chances of NICU admissions

1. LBW - 65 times increased risk with increase in severity of anaemia.
2. Poor APGAR score – 29.3 times increased risk with increase in severity of anaemia.
3. NICU admission 27.5 times increased risk with increase in severity of anaemia.

Cord blood hemoglobin decreases significantly with decreasing maternal hemoglobin. There is linear relationship between maternal and cord blood hemoglobin. There is 18.3 times increased risk of developing neonatal anaemia (cord blood hemoglobin<14gm/dl) with increase in severity of maternal anaemia.

Government has introduced multiple programmes/schemes for the control and prevention of maternal anaemia. But still the prevalence is high among rural population.

6. Source of Funding

None.

7. Conflict of Interest

The author declares no conflict of interest.

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