Original Article

Indian Journal of Trauma and Emergency Pediatrics
Volume 7 Number 2, April - June 2015

Study of Correlation of Maternal Haemoglobin with Birth Weight, Gestational Age and Cord Blood Haemoglobin

Suman Fathima*, Sunil Kumar P, Nisarga R*****

Abstract

Background: Anemia is one of the main nutritional deficiency disorders affecting a large proportion of the population, not only in developing but also in industrialized countries. Anemia in pregnancy is an important preventable cause of maternal and fetal morbidity and mortality. *Materials and Methods:* All the singleton live born babies born at Adichunchanagiri Institute of Medical Sciences, Mandya from December 2012 to November 2013. Maternal haemoglobin sampling was done under aseptic precautions. To know the severity of anemia, the cases were further divided as per ICMR criteria and 2 ml of cord blood was collected after delivery of the baby for measuring neonate's cord blood hemoglobin levels. Cord blood < 14 g / dl was considered as neonatal anemia. *Results:* 1269 mothers in the third trimester were included and hemoglobin estimation was done. 47 (21.36%) anemic mothers had preterm babies. 70(6.67 %) of non anemic mothers had preterm deliveries. Term deliveries constituted (90.8%), 979 (93.32%) were born to non anemic mothers and 173 (78.63%) to anemic mothers. Incidence of low birth weight babies was 24% of which extremely low birth weight babies constituted 1.31%, very low birth weight of 4.26% and low birth weight were 964(94.42%). *Conclusion:* Incidence of preterms, IUGR, low APGAR at 1 min, NICU admissions and neonatal anemia was higher in mothers with anemic Hb levels.

Keywords: Pregnancy; Anaemia; Birth Weight; Gestational Age.

Introduction

Anaemia is defined from Greek word without (am) blood (Haem) meaning-No Blood. Anaemia in pregnancy is one of the most important public health problems not only in India but also in most of the South East Asian countries [1].

Anaemia (defined by the World Health Organization as haemoglobin levels of ≤ 11 g / dl) is one of the world's leading causes of disability, and thus one of the most serious global public health problem. It is the most common nutritional deficiency disorder in the world. WHO has estimated the prevalence of anaemia in pregnant women are 14 % in developed and 51% in developing countries and 65-75 percent in India [2].

About one third of the global population (over 2 billion) is anaemic and India has reported high prevalence of anaemia in pregnancy [3]. Anaemia affects nearly half of all pregnant women in the world. The prevalence of anaemia ranges from 33% to 89% among pregnant women and is more than 60% among adolescent girls with wide variations in different regions of the country. India contributes to about 80 per cent of the maternal deaths due to anaemia in South Asia [4].

According to the Federation of Obstetric and Gynaecological Societies of India – WHO study (1997), anaemia is responsible for 64.4% of maternal death in India [5]. Most of the population in India lives in rural areas where the better health care services are not available to them. South Asia is the region of the world with the least antenatal care coverage. Only 54% of pregnant women go for one or less Antenal care (ANC) visits [6].

Adverse perinatal outcome in the form of preterm and small for gestational age (SGA) babies low birth

Author Affiliation: *Resident, **Assistant Professor ***Professor, Department of Pediatrics, Adichunchanagiri Institute of Medical Science, B.G. Nagara - 571448, Karnataka, India.

Reprint request: Suman Fathima, Resident, Department of Pediatrics, Adichunchanagiri Institute of Medical Science, B.G. Nagara - 571448, Karnataka, India.
E-mail: ramspsm@gmail.com

weight babies (LBW), Intra uterine growth restriction (IUGR) and increased perinatal mortality rates have been observed in neonates of anemic mothers.

The extent up to which, maternal anaemia effects maternal and neonatal health is still uncertain. Maternal iron deficiency and anaemia render the offspring vulnerable for developing iron deficiency and anaemia right from infancy.

Preterm and or low birth weight (PT/LBW) continues to be a significant cause of infant morbidity and mortality. PT/LBW is associated with risk for mortality in the first year of life, with developmental problems in childhood, and with risk of several diseases in adulthood [7].

More than 60% of the mortality that occurs among infants without anatomic or chromosomal congenital defects is attributable to low birth weight (LBW) [8]. The prevalence of preterm birth varies from 6% to 15% of all deliveries, depending on the population studied, and the prevalence has risen in recent years [9].

Early in this millennium, India and Nations around the world committed themselves to achieve the Millennium Development Goals. Goal factor aims to reduce under 5 mortality by 2/3rd between 1990-2015. This means reducing under 5 mortality to 36 per 1000 live births and the Infant Mortality Rate(IMR) to 27/1000 live births.

Today, while there have been encouraging signs, India's IMR remains high at 42/1000 live births. The most challenging part of infant mortality is the large proportion of new born deaths, Contributing to an estimated 64% of all infant deaths, mostly in the first week of life [10].

Major causes of neonatal mortality are diseases associated with preterm birth, low birth weight babies(LBW) and lethal congenital anomalies. Thus birth weight is an important indicator of survival, future growth and overall development of the child. It is associated with socio-economic, clinical, racial, hereditary, personal and geographical factors [11]. Haemoglobin increases with advancing gestational age: at term, cord blood haemoglobin is 16.8 g/dL (14-20 g/dL); haemoglobin levels in very low birth weight (VLBW) infants are 1-2 g/dL below those in term infants. A haemoglobin value less than the normal range of haemoglobin for birth weight and postnatal age is defined as anaemia [12].

The mean cord blood haemoglobin value for the baby in Western Europe is reported to be 16.8 g/100 ml and it has been suggested that any value below 13.6 g/100 ml should be considered as foetal anaemia. Prevalence of foetal anaemia is high in areas where malaria and iron deficiency anaemia in pregnancy are common.

Methodology

All the singleton live born babies born at Adichunchanagiri Institute of Medical Sciences, Mandya from December 2012 to November 2013. Maternal haemoglobin sampling was done under aseptic precautions. To know the severity of anaemia, the cases were further divided as per ICMR criteria into mild, moderate and severe based on haemoglobin percentage as 10-10.9 g/dl, 7-10 g/dl and <7 g/dl respectively. 2 ml of cord blood was collected immediately in EDTA sample bottle after delivery of the baby for measuring neonate's cord blood haemoglobin levels. Cord blood < 14 g/dl was considered as neonatal anemia. Gestational assessment was confirmed using modified Ballard's score where babies were grouped into categories : Pre-term,Term and Post-term. Birth weight was recorded with electronic scales. The outcome was analyzed using SPSS for Windows (Version 19.0) software.

Results

Majority of mothers belonged to the age group of 21-25 years, 56.42% followed by teenage pregnancy < 20 years constituting 20.3%. 20% in 26- 30 years.

3.46 % were elderly mothers with age ≥ 30 years. Minimum age of mother was 18 years and maximum was 34 years.

Table 1: Maternal hemoglobin

	Maternal Hb				
	Severe(< 7)	Moderate (7 -9.9)	Mild (10 -10.99)	No Anaemia (> 11)	Total
Count	18	120	82	1049	1269
Percent	1%	9%	7%	83%	100%

It is observed that 82.7% (1049) of mothers had normal haemoglobin and 17.3% (220) had anaemia; 7 % were mildly anemic, 9 % were moderately anemic and 1 % severely anemic in the overall maternal study subjects.

Table 2: Mothers Peripheral Smear Blood Picture

Type of Blood Picture	No. of Anemic Mothers	%
Microcytic (MI)	119	54
Dimorphic Anaemia (D)	44	20
Macrocytic (MA)	9	4
Normocytic (N)	48	22

Majority of the women 119 (54%) in this study had microcytic hypochromic anaemia as compared to dimorphic anaemia being 44 (20%). Only 9 (4%) cases of megaloblastic anaemia was detected. Hence iron deficiency anaemia is the commonest nutritional anaemia.

Table 3: Relation of Maternal Hb and Gestational Age of Delivered Babies

Mothers HB	Gestational Age		Total
	<37 weeks	37 -40 weeks	
<7	10 (55.55%)	8 (44.44%)	18
7 -9.9	26 (21.66%)	94 (78.33%)	120
10 -10.99	11(13.41%)	71 (86.58%)	82
Total Anemic	47 (21.36%)	173 (78.63%)	220
>11 (Non-Anemic)	70(6.67 %)	979 (93.32%)	1049
Total	117	1152	1269

Chi-square = 46.81, df = 1, P=0.0001

Overall incidence of preterm labor was 9.2% (117). 47 (21.36%) anemic mothers had preterm babies. In severely, moderately and mildly anemic mothers 55.55 %, 21.66 % and 13.4 % of deliveries were preterm. 70(6.67 %) of non anemic mothers had preterm deliveries. Term deliveries constituted (90.8%), 979 (93.32%)were born to non anemic mothers and 173 (78.63%) to anemic mothers.

Table 4 : Mode of delivery with Mothers Hb

HB Status	Normal	C Section
Anemic	105 (47.70%)	115 (51.19%)
Non Anemic	548 (52.27%)	501 (48.80%)

Chi square = 0.873,df=1, p value=0.374

51.19 % of non-anemic mothers delivered through normal vaginal delivery versus 47.7 % in anemic mothers. 48.8% of non-anemic mothers underwent LSCS compared to 52.27 % of the anemic mothers. It was also observed that rate of C section was higher with severity of anaemia. Overall the most common indication for LSCS in was foetal distress (45%), followed by Cephalo Pelvic Disproportion (25%) and previous LSCS (23%).

Table 5: Relationship between Maternal Haemoglobin and Birth Weight

BWT	Maternal HB			Total		Total
	<7	7-9.9	10-10.99	Anemic	>11	
<1	2	0	0	2	2	4 (0.3%)
1-1.49	2	4	0	6	7	13 (1%)
1.5-2.49	14	112	49	175	113	288 (22.7%)
Total LBW	18 (9.83%)	116 (63.4%)	49 (26.77%)	183	122	305
>2.5	0	4	33	890	927	964 (76%)

In this study, there were 305 (24%) low birth weight babies, 60%(183) of the low birth weight infants were born to mothers with anemic levels of haemoglobin (with significant p value =0.00) of which 49 (26.77%), 116 (63.4%) and 18(9.83%) babies belonged to mild, moderate and severe anaemia respectively (p value=0.01).

Table 6: Correlation between Mother HB and Cord HB

Baby HB	Mothers Haemoglobin					Total
	Severe (<7)	Moderate (7-9.9)	Mild (10 -0.99)	Total Anemic	Normal (>11)	
<14 (Anemic)	10 (55.55)%	47 (39.16%)	29 (35.36%)	86/162 (53.08%) (39.09%)	76 (46.90%) (7.24%)	162 (12.76 %)
>14 (Non anemic)	08 (44.44%)	73 (60.83%)	53 (64.63%)	134 (12.10%) (60.90%)	973 (87.89%) (92.75 %)	1107 (87.23%)
Total	18	120	82	220	1049	1269

Chi square = 74.47, df=5 , P value = 0.001

It was observed overall incidence of neonatal anaemia was 12.76 %. 39.09% of anemic mothers had neonates with anaemia whereas 60.9% of anemic mothers had neonates with normal haemoglobin. It was observed 53.08% of anemic neonates were born of anemic mothers.

In severely anemic mothers 55.55% neonates were anemic, 39.16 % were anemic in moderately anemic mothers and 35.36% neonates were anemic in mildly anemic mothers. Whereas in non anemic mothers, 7.24% had anemic neonates and 92.75% were neonates with normal HB (p value of 0.37).

Discussion

In the present study, 1269 mothers were studies, among which 1049 (82.7 %) mothers were found to have normal haemoglobin (non anemic mothers) and 220 (17.3 %) mothers of low haemoglobin (anemic mothers). They were categorized accordingly and their outcomes were analyzed and evaluated with standard literature. 49.5% (627/1269) of women underwent LSCS, among which majority of women had moderate-severe anaemia which is similar with the study conducted by Emre Karasahin [13] in which the rate of caesarean section was 30.2%.

Iron deficiency anaemia results in impaired transport of haemoglobin and thus oxygen to uterus, placenta and foetus. It also causes tissue enzyme and cellular dysfunction. This mechanism can explain impaired myometrial contractility resulting in failure of progress of labour, atonic uterus, as well as placental dysfunction leading to preterm birth, low birth weight and growth restricted babies and perinatal deaths.

Anaemic mothers Vs non-anemic mothers	Normal delivery	LSCS
Awasti A et al [14] (2001)	69.5% Vs 89%	20.5% Vs 5%
Shrivasthava M et al [15] (1999)	46.6% Vs 69.6%	21.7% Vs 14.6%
Present study	47.7% Vs 51.19%	52.27% Vs 48.8%

305 (24%) women had low birth weight babies, majority of them belonged to moderate and severe anaemia which is consistent with the study conducted by Riffat et al [16] which is 29%, Lone FW [17] which is 13.4% and Umber et al [18] with 10% of Low birth weight babies.

In the study by Rangnekar et al [19], incidence of low birth weight is 66% vs 4% while in the present study it is 60% vs 40%. This shows that incidence of low birth weight babies is more in anaemic patients than normal patients.

It is estimated that 7.3 million perinatal deaths occur annually in the world [20] and by correcting anaemia; many of these can be prevented. In our study, low birth weight was seen more in anemic group than in non anemic group. Same has been

seen in a study conducted by Malhothra [21], whose results show that severe anaemia increased the risk of low birth weight.

	Rangnekar AG [19]	Agarwal P [22]	Present study
Low birth weight (<2.5kg)	66% vs 4%	57% vs 34%	60% vs 40%

Haemoglobin (Hb) levels in fetus increase with progression of pregnancy, reaching highest levels in life. Hb serves as iron reserve in fetus and is needed for the infant to adapt with anaemia. Many factors can decrease Hb levels at birth and lead to accelerated physiological anaemia Incidence of neonatal anaemia was 12.76 %, slightly lower than Sareen A. et al where it was reported as 19.44% [23].

The mean cord Hb level of the studied group was 15.4±1.6 g/dl similar to Vaziri et al. 13.24±1.77 g/dl, which was significantly lower than corresponding parameters cited Nelson's Textbook of Pediatrics (P value=0. 000). Also, there was a significant and direct correlation between Hb of umbilical cord blood, and maternal Hb and pattern of delivery. Hb levels in the umbilical cord blood of newborns delivered by cesarean section were lower than Hb levels of those with normal delivery [24]. A study carried out in Owerri [25] obtained a similar value for cord blood Hb (14.22g/dl) when compared with others (12.3g/dl) [26] and (13.29g/dl) [27].

This study showed that the Hb of the cord blood was significantly higher than the maternal blood samples hence corroborates an earlier study by Ezeilo et al [28].

The cord haemoglobin appears to show a linear relationship with maternal haemoglobin with cord haemoglobin being less in mothers who have anaemia. Mothers who had more severe anaemia had babies with lower cord haemoglobin. Previous studies have shown that there is a direct relationship between maternal and foetal haemoglobin [25,26,27].

This explains a dependence of foetal Hb level on certain maternal factors such as ferritin and hepcidin levels. Understandably, the relatively lower values of Hb and PCV observed in the maternal blood than in cord blood may be due to plasma volume expansion leading to haemodilution in pregnancy [29]. Indeed, key physiological changes in pregnancy, which modifies the chemical constitution of blood, amplifies transfer of some haematopoietic micronutrients, and increased utilisation of some of these micronutrients as defense mechanisms against pregnancy induced oxidative stress may lead to maternal depletion and low haematological values .Hence Mothers who had anaemia were more likely to deliver anemic babies i.e. babies with cord haemoglobin<14 g/ dl .Previous studies also suggest that iron supply to the placenta and the fetus is affected in maternal anaemia and the fetus takes iron in direct proportion to the levels available in the mother [30]. This results in a reduced haemoglobin in babies born to mothers who are anemic. Such babies would be more likely to develop significant anaemia at an earlier age than babies born to non-anemic mothers.

Conclusion

Neonatal anaemia was obsereved in 39.09% anemic mothers compared to 7.24% in non-anemic mothers

References

1. Purandare CA, Dalal RA and Purandare CB. Anaemia in Pregnancy. 1-59.
2. Kalaivani K. Prevalence and consequences of anaemia in pregnancy. Indian J Med Res 2009; 130: 627-33.
3. Allen LH. Anaemia and iron deficiency : Effects on pregnancy outcome. Am J Clin Nutr 2000 ; 71: 1280S-4S.
4. bbzxxWorld Health Organization. The prevalence of anaemia in women: a tabulation of available information. 2nd ed. Geneva: World Health Organization, 1992.
5. Bhatt R. Maternal mortality in India-FOGSI-WHO Study.J Obstet Gynecol Ind 1997; 47: 207-214.
6. Abou Carlo Z, Tessa W. Antenatal care in developing countries: promises, achievements and missed opportunities: an analysis of trends, levels and differentials, 1990-2001 WHO; 2003.
7. Scannapieco FA, Bush RB, and Paju S. Periodontal disease as a risk factor for adverse pregnancy outcomes. A systematic review. Ann Periodontol 2003; 8: 70-8.
8. Gibbs RS, Romero R, Hillier SL, Eschenbach DA, and Sweet RL. A review of premature birth and subclinical infection. Am J Obstet Gynecol 1992; 166: 1515-28.

9. Madianos PN, Bobetsis GA, Kinane DF. Is periodontitis associated with an increased risk of coronary heart disease and preterm and / or low birth weights ? J Clin Periodontol 2002; 19 (Suppl.3): 22-36.

10. Thacker N. Integrated management of neonatal and childhood illness: A new hope for child survival. President's Page. Indian Paediatrics 2007; 44: 169-71.

11. Huque F, Hussain AMZ. Detection of low birth weight newborn babies by anthropometric measurements in Bangladesh. Indian Journal of Paediatrics 1991; 58(2): 223-31.

12. Maheshwari A and Carlo WA. Anaemia in newborn infant. In: Nelson textbook of pediatrics.19th ed. Philadelphia: Elsevier Saunders. 2012; 97(1): 612-5.

13. Emre Karas'ahin , Maternal anaemia and perinatal outcome, Perinatal Journal., 2007; 15(3): 127 - 130 Articles.

14. Awasthi A, Thakur R. Dave A, Goyal V. Maternal and perinatal outcome in cases of moderate and severe anaemia. J Obstet Gynecol India 2001;57(6): 62-5.

15. Garshasbi A, fallah N. Maternal hematocrite level and risk of low birth weight and preterm. Tehran Univ. Med. J., 2007; 64(4): 87-94.

16. Riffat Jaleel; International journal of surgery,13(4) October-December 2008.

17. Lone, F. W., Qureshi, R. N. and Emanuel, F. Maternal anaemia and its impact on perinatal outcome. Tropical Medicine & International Health, 9: 486–490. doi: 10.1111/j.1365-3156.2004.01222.

18. Umber Jalil Bakhtiar, Relationship between maternal haemoglobin and outcome, june 18, 2007.

19. Rangnekar AG, Darbari Rashmi. Foetal outcome in pregnancy anaemia. J Obstet Gynaecol India 1993; 43(2): 72-176.

20. Shazia T, Faheem S, Saad R.Perinatal mortality: A survey. Pak J Obstet Gynaecol 1994; 7: 1-8.

21. Malhotra M. Sharma JB. Batra S, Sharma S,Murthy NS, Arora R. Maternal and perinatal outcome in varying degrees of anaemia. Int J Gynaecol Obstet 2002; 79: 93-100.

22. Agrawal RMD, Tripathi AM, Agrawal KN. Cord blood haemoglobin, iron and ferritin status in maternal anaemia. Acta Paediatr Scand 1983; 72: 545–8.

23. Aarti Sareen, Kusum Mahajan,Satnam Singh. Maternal Anaemia and its Effect on Cord Haemoglobin. Indian Medical Gazette May 2013; 161-163.

24. Shahla Vaziri Esfarjani, Lida Asghari Nejad. Comparing Mean Haemoglobin Levels Of Umbilical Cord Blood In Neonates With Maternal Haemoglobin And Delivery Pattern. Journal Of Isfahan Medical School. 24: 82.

25. Onwukeme KE and Uguru VE. Hematological values in pregnancy in Jos. West Afri J Med 1990; 9: 770-5.

26. Onwukeme KE, Olomu IN and Nnanna OU. Hematological indices of healthy Nigerian neonates. Nig Med Pract 1993; 23: 9-12.

27. Dapper DV and Didia BC. Haemorheological parameters of umbilical cord blood of Nigerian newborns: Correlations with maternal parameters. W Afr J Med 2006; 25(1): 226-30.

28. Ezeilo GC. Hematological Values in pregnant Zambian women. Trop Geogr Med J. 1972; 24: 252-8.

29. Ezeilo GC. Hematological Values in pregnant Zambian women. Trop Geogr Med J. 1972; 24: 252-8.

30. Abudu OO and Sofola OA. Relationship between Red cell mass and packed cell volume in Nigerian Primigavidae. Nig J Physiol Scis. 1994; 10(1-2): 13 –21.

31. Al-hilli N.M. — The Effect of Maternal Anaemia on Cord Blood Haemoglobin & Newborn Birth Weigh Karbala.Journal of Medicine. 2010; 2: 8-9.