

## SHORT COMMUNICATION

# Maternal Anemia and its Correlation with Iron status of Newborn

AKHTER S<sup>a</sup>, MOMEN MA<sup>b</sup>, RAHMAN N<sup>c</sup>, RAHMAN S<sup>d</sup>, KARIM R<sup>E</sup>, SELIM S<sup>f</sup>, RAHMAN A<sup>g</sup>

### Abstract:

**Aim:** To investigate the correlation of maternal blood Hb level and iron stores with neonatal iron status.

**Methods:** A cross sectional analytic study on was conducted on fifty hospitalized pregnant women and their neonates over one year in a teaching hospital in the capital city of Bangladesh. Paired samples (50) of maternal venous and neonatal Women who had no medical complications and had undergone caesarian section were included. Maternal serum and cord hemoglobin concentrations with ferritin values were measured immediately after delivery. Placental weight, birth weight and APGAR scores were recorded.

**Result:** The study involved 50 participants, randomly selected, of whom 10 had normal iron status and others had mild to severe anemia. Our study found no significant correlation of maternal Hb and cord Hb levels. But maternal serum ferritin showed positive correlation with cord ferritin ( $r=0.94$ ;  $P<0.001$ ) and with placental weight ( $r=0.40$ ;  $p<0.001$ ).

**Conclusion:** Maternal iron deficiency anaemia was strongly associated with lower iron status of newborn

**Key Words:** Maternal iron deficiency anemia; cord iron status, placental weight.

(Birdem Med J 2014; 4(1): 27-32)

### Introduction:

It is generally agreed that the most common forms of nutritional disorder during pregnancy in developing & developed country are iron deficiency anemia (IDA) and folic acid deficiency.<sup>1</sup> Both IDA and folic acid deficiency can lead to anemia.<sup>2</sup> Anemia is defined by

- Dr. Shohela Akhter, MD (Paed.), Associate Professor, Department of Paediatrics, Bangabandhu Sheikh Mujib Medical University (BSMMU)
- Dr. Md. Abdul Momen, FCPS Surgery, Associate Professor & Head, Department of Surgery, Rajshahi Medical (RMC)
- Dr. Nadia Rahman, FCPS Physical Medicine, Medical Officer, Department of Physical Medicine & Rehabilitation
- Dr. Samima Rahman, MBBS, Medical Officer, Department of Obstetrics & Gynaecology Central Hospital.
- Dr. Rezaul Karim Kazal, FCPS (Obs & Gynae), Associate Professor, Department of Obstetrics & Gynaecology, BSMMU
- Dr Shahjada Selim, Department of Endocrinology & Metabolism BIRDEM Hospital, Dhaka
- Dr. Md Atiar Rahman, MBBS ,FCPS, MD, Associate Professor of Pulmonology Department of Paediatrics, Bangabandhu Sheikh Mujib Medical University (BSMMU),

Address of correspondence: Dr. Shohela Akhter, Associate Professor, Department of Paediatrics Bangabandhu Sheikh Mujib Medical University (BSMMU), Cell Phone: +8801720038503, E.mail: drzharna@gmail.com

**Received:** February 14, 2013 **Accepted:** December 31, 2013

the world health organization (WHO) as haemoglobin (Hb) levels of 11 gm/dl.<sup>3</sup> The maternal anemia which sometimes reaches very low level and may be associated with prematurity, reduced neonatal weight, infant iron deficiency anaemia and decreased school performance<sup>4,5</sup>. Maternal anemia is also suspected to markedly reduce the oxygen supply to the fetus, which may be responsible for fetal blood flow redistribution despite there being no evidence of placental insufficiency.<sup>6</sup> Below a certain level of Hb content there could have direct relationship between maternal Hb level and fetal PO<sub>2</sub>.<sup>7,8</sup> Anemic in preschool children have been found to differ in associative reaction time, vocabulary and IQ test scores from nonanemic children.<sup>9</sup> It is also demonstrated that lower levels of neonatal Hb and serum iron are related to higher level of negative emotionality and to lower levels of alertness and soothability. A similar effect also found for low ferritin level.<sup>10</sup> Iron is actively transported from mother to the fetus.<sup>11</sup> In the iron deficiency state, there is up regulation of iron transport protein in the placenta, which ensures the adequate iron supply to the growing fetus.<sup>11</sup> But this protective mechanism might fail in severe maternal anemia leading

to an insufficient iron supply to the fetus & breast milk.<sup>12,13</sup> It seems that maternal anemia is for her fetus an acute and reversible aggression. Women who do not take iron supplements frequently deplete their iron stores during the second and third trimesters of pregnancy and hemoglobin concentration is low than supplemented women.<sup>14-16</sup> The relationship between maternal and fetal iron transfer the fetus may depend<sup>17-21</sup> on or be independent<sup>22-26</sup> of maternal iron status. Rationale of this study was to assess the effect of maternal Hb & ferritin on newborn Hb and ferritin that can be prevented largely by undertaking anemia control programmes.

#### **Methods:**

50 hospitalized pregnant women who were considered for caesarian section irrespective of gestation age, were selected. Women with the evidence of tuberculosis, diabetes mellitus, essential hypertension, UTI & antepartum hemorrhage were excluded from the study.

#### **Collection of samples & laboratory analysis:**

Paired maternal & cord blood samples were collected just after delivery in iron free polyethylene tubes from the mothers' antecubital vein during the first stage of labor & from the placental end of the umbilical cord without milking for the estimation of (Hb) by cyanmethemoglobin method<sup>27</sup> and serum ferritin by the enzyme linked immunosorbent assay method (ELISA).<sup>28</sup> Routine hematological measurements of maternal blood sample (MCV, MCH, MCHC, & reticulocyte count) were performed on automated cell counter (ABOTT CELL-DYN 3500, USA).

#### **Maternal Questionnaire:**

Women who agreed to participate in the study were given a comprehensive questionnaire consisting primarily of true-false questions regarding betel, jorda, drug consumption, smoking prior to and during pregnancy. All questions were asked orally by same research assistant. Questionnaire items regarding betel with jorda and smoking habits were viewed as beings of particular interest in the present study because they cause vasoconstriction.<sup>29</sup>

#### **Measurements & records:**

Birth weight, APGAR scores and placental weight were recorded immediately after delivery & neonate was

examined for evidence of respiratory distress syndrome, PDA & congenital abnormality. Birth weight was recorded on a weighing scale with 10 gm differentiation. Five objective signs of appearance (color), pulse (heart rate), grimace (response to catheter put into nostril after oropharyngeal clearance), activity (muscle tone) and respiration (APGAR) scores were recorded following 01 minute & 05 minutes of complete birth. The placenta was collected

immediately after delivery. The umbilical cord was cut 1 cm from the fetal surface and the membranes trimmed. Adherent blood clots were removed from the placenta and subchorionic vessels were emptied of blood by gentle pressure. The placenta was blotted several times and then weighed.<sup>30</sup>

#### **Statistical analysis:**

All the variables were analyzed for statistical significance using the correlation coefficient (r) test- in Microsoft Excel Data Analysis Tool pack.

#### **Observations & Results:**

50 selected women were divided into four groups on the basis of (Hb). Using the WHO cut-off values (<11 gm/dl), 18 (36%) (Group I, n=06 & Group II, n=12) of the 50 pregnant women were anemic (Table-1). Maternal haemoglobin (Hb) concentration showed a highly significant positive correlation with MCH, MCHC and serum ferritin (r=0.69), 0.44 and 0.92, respectively; (P <0.001) indicating that iron deficiency was the most dominant factor in the causation of anemia amongst them (Table-I). MCV showed no significant intergroup variations and no correlation with haemoglobin concentration. There was no macrocytosis. Maternal Hb significantly correlate with cord ferritin (Table-I, Fig-D). Table-I also showed maternal serum ferritin also correlated positively with cord ferritin (r=0.94; P <0.001) (Table-I, Fig-2). Table-II showed no significant correlation of maternal Hb and cord Hb. The maternal (Hb) showed a significant correlation with birth weight (r=0.35; P <0.001), placental weight (r=0.40; P <0.001), (Table III, Fig.-3,4), APGAR score (r=0.52; P <0.001) (Table-III).

**Table-I**

*Haemoglobin concentration and mean values of red cell indices in pregnant women in different groups with respective maternal and cord ferritin (n=50)*

Maternal Hb concentration Group (g/dl)	Serum ferritin (µg/L) Range (Mean ± SD)	Cord ferritin (µg/L) Range (Mean ± SD)	MCV (fl) (Mean ± SD)	MCH(pg) (Mean ± SD)	MCHC (g/dl) (Mean ± SD)
I (n=6) <9.0	5-20 (19.83±5.84)	20-45 (32.50±9.35)	80.00 (±3.84)	25.10 (±2.92)	28.00(±1.78)
II (n=12) 9.1-10.9	10-50 (20.12±12.65)	15-80 (39.00±19.65)	84.75 (±2.70)	27.33 (±2.41)	30.50(±2.27)
III (n=22) 11.0-12.9	20-100 (46.81±22.37)	25-220 (77.27±48.73)	88.75 (±4.22)	28.59 (±1.54)	31.50(±2.68)
IV (n=10) >13.0	30-140 (88.8±36.52)	35-250 (131.00±79.99)	93.20 (±2.96)	29.70 (±1.58)	31.70(±1.87)
r with maternal haemoglobin concentration	0.92	0.48	-	-	-
P value	0.001	0.001	-	-	-
r with maternal ferritin	-	0.94	-	-	-
P value	-	0.001	-	-	-

**Table-II**

*Haemoglobin concentration in pregnant women in different groups with respective cord haemoglobin*

Group	Maternal haemoglobin Concentration (g/dl) Range (Mean ± SD)	Cord haemoglobin concentration (g/dl) Range (Mean ± SD)
I (n=6)	6.9-9.9 (8.2 ± 0.81)	15.0-17.5 (16.33 ± 1.17)
II (n=12)	9.1-10.9 (10.37 ± 0.36)	15.6-20.0 (17.42 ± 1023)
III (n=22)	11.0-12.9 (11.75 ± 0.57)	16.5-20.5 (17.27 ± 1.61)
IV (n=10)	13.0-15.0 (13.74 ± 0.58)	15.0-21.0 (17.65 ± 1.37)

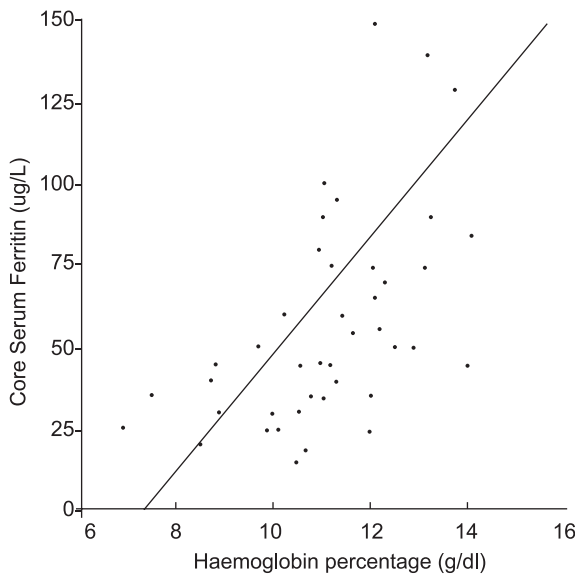
**Table-III**

*Percentage of low birth weight, low placental weight, birth asphyxia, APGAR score and low gestational age*

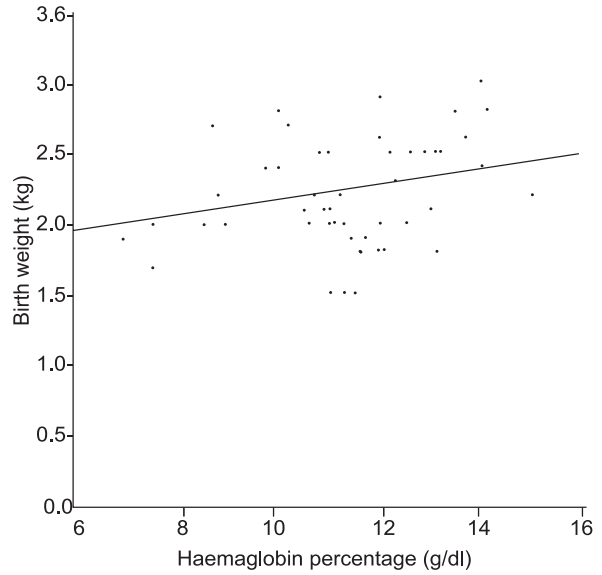
Groups	Birth weight <2.5 kg	Apgar score <8	Placental weight <250g
I	83.99%	33.33%	66.66%
II	58.33%	16.66%	8.9%
III	72.2%	22.72%	4.54%
IV	40.0%	0	2.2%
r with maternal haemoglobin concentration	0.35	0.52	0.40%
P value	0.001	0.001	0.001

**Table-IV**

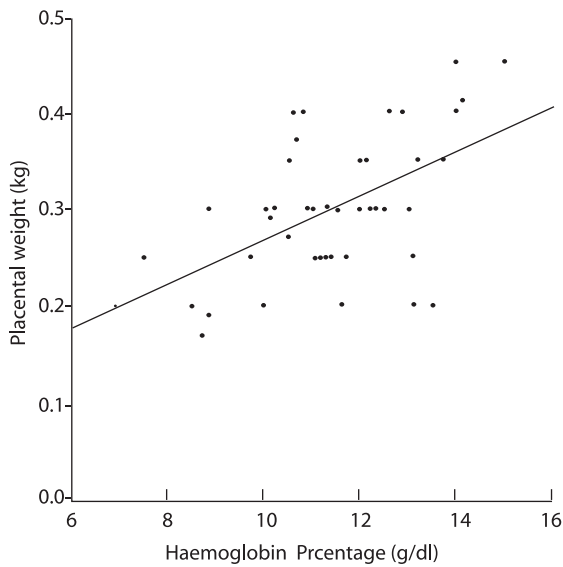
Group	Monthly income in Taka Present study	Study of Rusia et al. (1995)
I	1000	600
II	1500	519
III	3000	1245
IV	3500	2078



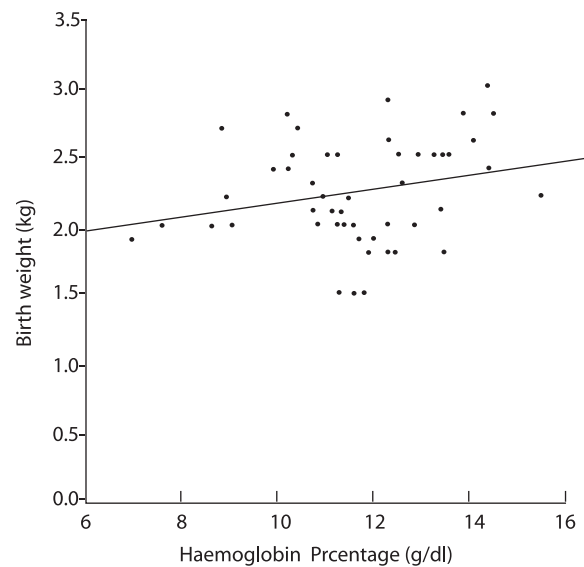
**Fig.-1:** Correlation of maternal haemoglobin with cord ferritin



**Fig.-2:** Correlation of maternal haemoglobin with placental weight



**Fig.-3:** Correlation of maternal haemoglobin with birth weight



**Fig.-4:** Correlation of maternal haemoglobin with placental weight

**Discussion**

The results of the present study indicate that according to WHO cut-off value (11 gm/dl) 36 percent of pregnant women were anaemic. Based on previous research, this proportion was consistent with other studies where 35%-75% of the women were found s anemic.<sup>31</sup> The distribution of age, parity and family income in the

present study are in accordance with the other studies.<sup>32</sup> A correlation between the maternal (Hb) and the family income suggest that undernutrition might have played an important role in the causation of anaemia (Table IV). In the present study, there was a highly significant positive correction of maternal hemoglobin concentration with MCHC and serum ferritin. There was

progressive increase in mean serum ferritin values from groups-I to group-IV, with rising hemoglobin concentration. Thus it is evident that iron deficiency played a dominant role in the causation of the anaemia of pregnant mothers. Analysis of the study group showed no statistical relationship between maternal venous and fetal cord blood (Hb). This result suggested that [Hb] of mother did not influence the cord hemoglobin concentration. But in contrast to other study, we found that there is significant positive correlations between maternal hemoglobin concentration and maternal ferritin with the with cord ferritin. Rusia et al, found that maternal haemoglobin did not correlate with cord blood haemoglobin, but maternal ferritin and haemoglobin were found to correlate positively with cord ferritin<sup>32</sup> which is consistent with our study. Fenton et al.<sup>33</sup> and Milman et al.<sup>34</sup> also showed that maternal ferritin correlated with cord as newborn ferritin level. Sisson and Lund<sup>35</sup>, Nhonoli et al.<sup>36</sup> and Singla et al.<sup>37</sup> found that Newborn and maternal haemoglobin had a linear correlation with [Hb] iron level in the cord blood and placental tissue. Diane E et al,<sup>26</sup> and Cantwell et al.<sup>38</sup> demonstrated that fetal-cord-blood haemoglobin levels were similar in anaemic and mothers. Turkay et al.<sup>39</sup> and Bhargava et al.<sup>40</sup> found no correlation between maternal haemoglobin and ferritin at 16 and 34 weeks' gestation and newborn haemoglobin parameters. Supporting theory is that (for women with mild-to-moderate anemia) the placenta and fetus

have a special affinity for iron in the mother's circulation and iron is transported through the placenta irrespective of the concentration gradient.<sup>39</sup> But in our study placental weight decreased with the severity of maternal anemia. So, it may be one of the important cause of correlation between maternal haemoglobin and ferritin and newborn haemoglobin parameters, which ultimately caused neonatal anaemia. It is surprising that, women were asked to have any perception they held about the condition of anemia. Approximately half the women were not at all familiar with the term. There are large numbers of women who do not have any perinatal care during pregnancy. The people's awareness of iron deficiency anemia and its adverse effects, must be increased in developing countries.

### Conclusion

Maternal iron deficiency anaemia was strongly associated with lower iron status of newborn. So iron

supplementation to the pregnant women may alter the iron status of newborn.

### References

1. Vaughn J, Brown J, Carter JP. The effects of maternal anemia on fetal behavior. *Journal of the national medical association*. 1986; 78 (10) : 963-968.
2. Committee on Maternal Nutrition, Food and Nutrition Board. *Maternal nutrition and the course of pregnancy*. Washington, DC: National Academy of Sciences, 1970.
3. *Nutritional anaemias Report of a World Health Organization Group of Experts (Technical Report Series No. 503)*. Geneva: WHO, 1972.
4. Stefanvic M, Milosavljevic M, Janosevic DR, Kutlesic R, Vukomanovic P. Maternal anaemia and fetal cerebral hemodynamic response Doppler assessment. *Factia Universitatis*. 2005; 12, (2): 93-96.
5. Steep P, Ash A, Wadsworth J, Welch A. Relation between maternal hemoglobin concentration and birth weight in different ethnic group. *BMJ* 1996; 310: 489-92.
6. Allen LH, Anaemia and iron deficiency: effects on pregnancy outcome. *Am J Clin Nutr Suppl*. 2000; 71: 1280-4.
7. Kurmanavicius J, Streicher A, Wright EM, Wisser J, Muller R, Royston P, et al. Reference values of fetal peak systolic blood velocity in the middle cerebral artery at 19-40 weeks of gestation. *Ultrasound Obstet Gynecol*. 2001; 17: 50-3.
8. Bahlmann F, Reinhard I, Krummenaver F, et al. Blood flow velocity waveforms of the fetal middle cerebral artery in a normal population: Reference values from 18 weeks to 42 weeks of gestation. *J Perinat Med*. 2002; 30: 490-501.
9. Wachs TD, Pollitt E, Cueto S, Jacoby E, Kanashiro HC, Relation of neonatal iron status to individual variability in neonatal temperament. *Wiley Inter Science (www.interscience.wiley.com)*. Oct. 2004.
10. Sulzer JL, Wesley HH, Leonig F, Nutrition and behavior in Head Start children. Results from the Tulane study. In: Kallen DJ, ed. *Nutrition, Development and Social Behavior*. DHEW publication No. 73-242. Government Printing Office, 1973.
11. Bentley DP. Iron metabolism and anaemia in pregnancy. *Clin Haematol*. 1985; 14 (3): 613-638.
12. Gambling L, Danzeisen R, Lea RG, et al. placental transfer and expression transport proteins in vivo and in vitro. *Biochem J*. 2001; 356 (pt 3): 883-889.
13. Kumar A, Rai AK, Basu S, Dash D, Singh JS. Cord blood and breast milk iron status in maternal anemia. *Pediatrics*. 2008; Feb 29, 121(3): 673-677.

14. Svanberg B, Arvidsson B, Norrby A, Rybo G, Golvell L. Absorption of supplemental iron during pregnancy. *Acta Obstet Gynecol Scand*, 1975; 48 (Suppl):87-108.
15. Poulakka J, Janne O, Pakarinen A, Jarbinen PA, Vihco R. Serum ferritin is a measure of iron stores during and after normal pregnancy with and without iron supplements. *Acta obstet Gynecol Scand*, 1980; 95 (Suppl): 43-51.
16. Taylor DJ, Mallen C, McDopugall N, Laind T. Effect of iron supplementation on serum ferritin levels during and after pregnancy. *Br J Obstet Gynecology*, 1982; 89: 10011-7.
17. Singla PN, Tyagi M, Shankar R, Dash D, Kumar A. Foetal iron status in maternal anaemia. *Acta Paediatr*. 1996; 85(11): 1327-1330.
18. Preziosi P, Prunel A, Galan P, Dauda H, Boureima H, Hereberg S. Effects of iron supplementation on the iron status of women: consequences for newborns. *Am J Clin Nutr*. 1997; 66(5): 1178-1182.
19. Halvorsen S. Iron balance between mother and infant during pregnancy and breastfeeding. *Acta Paediatr*. 2000; 89 (6): 625-627.
20. Choi JW, Kim CS, Pai SH. Erythropoietic activity and soluble transferrin receptor level in neonates and maternal blood. *Acta Paediatr*. 2000; 89 (6): 675-679.
21. Sweet DG, Savage G, Tubman TR, Lappin RT, Halliday HL. Study of maternal influences on fetal iron status at term using cord blood transferrin receptors. *Arch Dis Child Fetal Neonatal Ed*. 2001; 84 (1): F40-F43.
22. Gebre-Medhin M, Birgegard G. Serum ferritin in Ethiopian mothers and their newborn infants: relation to iron intake and socioeconomic conditions. *Scand J Haematol*. 1981; 27(4): 247-252.
23. Wong CT, Saha N. Interrelationships in the storage of iron in the mother, the placenta and the newborn. *Acta Obstet Gynecol Scand*. 1990; 69(7-8):613-616.
24. Kilbride J, Baker TJ, Parapia LA, Khoury SA, Shuquaiedf SW, Jerwood D. Anaemia during pregnancy as a risk factor for iron-deficiency anaemia in infancy: a case-control study in Jordan. *Int J Epidemiol*. 1999; 28(3): 461-468.
25. Harthoorn-Lasthuizen EJ, Lindemans J, Langenhuijsen MM. Does iron deficient erythropoiesis in pregnancy influence fetal iron supply? *Acta Obstet Gynecol Scand*. 2001; 80(5): 392-396.
26. Emery D, Barry D. Comparison of Maori and non-Maori maternal and fetal iron parameters. *NZX Med J*. 2004; 117 (1195): U909.
27. Crosby WH, Munn JI, Furth FW. Standardising a method of clinical hemoglobinometry. *US Armed Forces Med J*. 1953; 5(5): 693-696.
28. Linpisarn S, Kricha LL, Kennedy JH, Whitehead TP. Sensitive sandwich enzyme immunoassay for serum ferritin on microtitre plate. *Am Clin Biochem*. 1981; 18 (Pt 1): 48-53 [Medline].
29. Norma B, Lerner and Richard S. Iron –Deficiency Anemia. In: Nelson EW, Behrman ER, Kliegman Mr, Arvin MA, eds. *Nelson Text Book of pediatrics*. 19<sup>th</sup> ed. Prism books Pvt. Ltd. Bangalore, 2012; P 1655-1658.
30. Rusia U, Bhatia A, Kapoor S, Madan N, Nair V, Sood SK. 1988. Placental morphology and histochemistry in iron-deficiency anaemia. *Indian J Med Res* 87: 468-74.
31. Allen LH. Anemia and iron deficiency: effects on pregnancy outcome.” *The American Journal of Clinical Nutrition*. April 2000; 71(suppl): 128OS-4S.
32. Rusia U, Madan N, Agarwal N, et al. Effect of maternal iron deficiency anaemia on foetal outcome. *Indian J Pathol Microbiol*. 1995; 38:273-9.
33. Fenton V, Cavill I, Fisher J. Iron stores in pregnancy. *Br J Haematol*. 1977; 37: 145-8.
34. Milman N, Ibsen KK, Chirstensen JM. Serum ferritin and iron status in mother and newborn infants. *Acta Obstet Gynaecol Scand*. 1987; 66:205-11.
35. Sisson TRC, Lund CJ. The influence of maternal iron deficiency on the newborn. *Am J Dis Child*. 1957; 94:525.
36. Nhonoli AM, Kihama, FE, Ramji BD. The relation between maternal and cord serum iron levels and its effect on foetal growth in iron deficient mothers without malarial infection *Br J Obster Gynaecol*. 1975; 82:467.
37. Singla PN, Chand S, Khanna S, Agarwal KN. Effect of maternal anaemia on the placenta and the newborn infant. *Acta Paediatr Scand*. 1978; 67:645-8.
38. Cantwell RJ. Iron deficiency anemia of infancy: some clinical principles illustrated by the response of Maori infants to neonatal parenteral iron administration. *Clin Pediatr*. 1972;11:443-9.
39. Turkay S, Tanzer F, Gultekin A, Bakici MZ. The Influence of maternal iron deficiency anaemia on haemoglobin concentration of the infant. *JH Trop Pediatr*. 1995;41:369-371.
40. Bhargave M, Kumar R, Iyer PU, et al. Effect of maternal anaemia and iron depletion on foetal iron stores, birthweight and gestation. *Acta Paediatr Scand*. 1989;78:321-2.