© Kamla-Raj 1997

J. Hum. Ecol., 8(5) : 391-396 (1997)
DOI: 10.31901/24566608.1997/08.05.10

Maternal and Neonatal Hematological Parameters in Rural Punjabi Population as Influenced by Nutrition Counselling and Medical Supervision

Rajbir Sachdeva and Sukhwant K. Mann

Department of Foods and Nutrition, College of Home Science, Punjab Agriculture University, Ludhiana 141 004, Punjab, India

KEY WORDS Trimester. Blood. Nutrient Supplements. Medical Supervision. Pregnant Women.

ABSTRACT Sixty young women from low and lower middle income groups were selected from 8 villages of Ludhiana district in I Trimester of pregnancy and divided equally into Experimental (E) and Control (C) groups. Iron (60 mg), folic acid (500 µg), calcium gluconate (500 mg), ascorbic acid (15 mg), vitamin B_{12} (1 µg) and vitamin D_3 (100 I.U.) were supplied to E group from 5th month till delivery along with regular medical supervision and nutrition counselling. Intake of all the nutrients were less than the Recommended Dietary Allowances in the E and C groups during I and III Trimesters. However, the requirement of iron, folic acid, vitamin B_{12}, ascorbic acid were met in the E group due to supplementation. The Fe, Ca and Cu levels improved significanly ($P \leq 0.01$) during III Trimester in E group. The cord serum levels of Fe, Ca and Cu were also significantly ($P \leq 0.01$) higher in E group. The relationship between maternal and cord blood levels of Fe, Ca, Cu and Zn were significant ($P \leq 0.01$), the coefficients of correlation being 0.67, 0.92, 0.97 and 0.43 respectively ($P \leq 0.01$). Nutritional counselling significantly improved the haemopoetic indices of the pregnant women and their neonates.

INTRODUCTION

Anaemia is a major and pressing problem among pregnant women in India, being as high as 60-70% (Gopalan, 1985). It is also the commonest complication reported during pregnancy in India. Maternal anaemia is associated with an increased prenatal mortality and morbidity. Anaemia induces irreversible changes in placental morphology, morphometry and histology. Such placenta has reduced iron content and total mitochondrial and cytoplasmic protein levels. The transfer of iron from mother to foetus is proportionately reduced, resulting in low foetal hepatic iron content (Aggarwal, 1990).

The maternal serum calcium declines during pregnancy because of the physiologic hypoalbuminemia (Pitkin, 1975). Prolonged dietary inadequacies of calcium, phosphorus and magnesium in pregnant women would affect the proper development, formation and maintenance of skeletal tissues and teeth (Omotunde et al., 1985). The low serum calcium levels during pregnancy have been attributed to low intake of available calcium as well as deficient intake of supplements (Fattah et al., 1978).

METHODOLOGY

Selection of Subjects : Sixty six pregnant women in the age group of 18-28 years from low and lower middle income groups from eight villages of Ludhiana district (Punjab) were chosen randomly and divided equally into Experimental (E) and Control (C) group.

Medical Supervision and Nutritional Supplements : The number of visits to Subsidiary Health Centre (SHC) made by each subject for medical check up were recorded both for E and C groups. The E group was provided with medical supervision and nutrient supplement *viz*. folifer tablets (60 mg iron, 500 µg folic acid) and calcium Sandoz tablets containing 500 mg of calcium gluconate, 15 mg ascorbic acid, 1 µg vit. B_{12} and 100 I.U. of vitamin D_3 regularly during II and III trimesters of pregnancy. The C group was provided medical supervision along with folifer tablets as per government practice.

Nutrition Counselling : A pamphlet about "Diet during pregnancy" was published in Pun-

jabi and distributed to the subjects of E group in their I trimester of pregnancy. Nutrition knowledge in the pamphlet was reinforced by four individual and three group contacts in the E group.

Biochemical Assessment : A series of hematological investigations like Haemo- globin (Hb), Haematocrit (HCT), RBC count, Mean Corpuscular Haemoglobin Concentration (MCHC), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Serum Iron, Total Iron Binding Capacity (TIBC), Unsaturated Iron Binding Capacity (UIBC), Transferrin Saturation, Serum Calcium (Ca), Zinc (Zn), Copper (Cu) and Manganese (Mn) were carried out during I and III trimesters. The Hb, HCT and RBC were tested in the Blood Cell Counter-PC 603 Erma, Inc, Japan. The values of MCV, MCHC and MCH were calculated. The method of Teitz (1976) was used for measuring the TIBC. The serum samples of the subjects for Fe, Ca, Zn, Cu and Mn were analysed in the Atomic Absorption Spectrophotometer (GBC -902) by the method of Piper (1950).

After birth of the neonates, the blood from the placental end of the cord was collected and the whole set of hematological tests listed above were also conducted.

Statistical Analysis : The results were analysed statistically in the computer. Correlation coefficients were calculated to measure the relationship of maternal mineral status with that of the new-borns. Analysis of variance (ANOVA) was used to study the effect of mineral supplements on maternal blood during III trimester and cord blood. Coefficient of correlation (r) was also calculated to study the relationship between maternal blood during III trimester and cord blood parameters.

RESULTS AND DISCUSSION

The demographic information of the subjects on the study revealed that the mean per capita income varied from Rs. 115 to 300 per

Table 1 : Haemopoetic indices of the pregnant women

Blood analysis	*I trimester*		*III trimester*		*Normal value*
	Experimental (n=33)	*Control (n=33)*	*Experimental (n=31)*	*Control (n=30)*	
	Average ± SE (CV %)	*Average ± SE (CV %)*	*Average ± SE (CV %)*	*Average ± SE (CV %)*	
Haemoglobin, b/dl	9.0 ± 0.09 (8.9)	8.4 ± 0.12 (9.2)	10.2 ± 0.07 (10.0)	8.5 ± 0.13 (10.2)	11.00[1]
Haematocrit, %	29.3 ± 0.3 (10.0)	27.4 ± 0.35 (10.3)	32.2 ± 0.24 (8.)	26.9 ± 0.28 (8.45)	32.36[2]
Red blood cell count x 10^6 mm^3	3.80 ± 0.07 (12.9)	3.52 ± 0.05 13.8)	3.85 ± 0.02 (11.8)	3.32 ± 0.04 (12.9)	4-4.5
MCHC, %	30.65 ± 0.2 (12.8)	30.6 ± 0.3 (13.8)	31.65 ± 0.18 (12.1)	31.02 ± 0.91 (13.3)	30-35[2]
MCV, U[3]	85.3 ± 0.6 (10.2)	87.02 ± 0.71 (11.1)	89.2 ± 0.6 (9.6)	82.96 ± 0.7 (10)	75-95[2]
MCH, pg	25.0±0.2 (8.2)	25.4±0.16 (8.3)	27.8±0.2 (7.2)	25.5±0.25 (7.5)	26-31[2]
Serum iron, µg/dl	47.6 ± 0.8 (20.1)	36.9 ± 0.8 (19.)	51.9 ± 1.1 (16.2)	38.27 ± 0.94 (23.2)	65-75[2]
TIBC, µg/dl	377.5 ± 4.0 (7.1)	390 ± 4.4 (8.1)	342.8 ± 4.03 (8.3)	408.4 ± 5.04 (9.02)	300-4001
UIBC, µg/dk	330.6 ± 4.5 (9.4)	357 ± 4.8 (10.1)	293 ± 4.4 (10.3)	357 ± 4.9 (10.9)	
Transferrin saturation, %	11.97 ± 0.4 (36.5)	9.47 ± 0.39 (38.8)	15.2 ± 0.4 (36.5)	8.51 ± 0.3 (27.5)	16[2]

1 WHO (1968) 2 Dutta (1988)

month in both the groups. The average per capita income in Punjab and India was Rs. 400 and Rs. 272 per month respectively (Anon, 1987). Out of 66 subjects, five subjects, two and three from E and C groups respectively aborted in the third month of their pregnancy and one newborn died during delivery. So finally sixty subjects were left.

I. Biochemical Assessment of the Subjects

The data in table 1 shows that the mean Hb, HCT, RBC, per cent transferrin saturation of the E and C groups during I trimester was 9.0 ± 0.09 and 8.4 ± 0.12 g/gl, 29.3 ± 0.3 and 27.4 ± 0.35 per cent, 3.80 ± 0.07 and 3.52 ± 0.05 x 10^6 mm^3, 11.97 ± 0.4 and 9.47 ± 0.39 per cent respectively. A further reduction in all the values was noted in mothers belonging to the Control group during III trimester. However, there was improvement in the above values in the E group during III trimester with the intake of iron and folic acid tablets. The difference in the mean haematological levels of the two groups during III trimester was highly significant ($p \leq 0.01$). These values were however below the normal levels suggested by WHO (1968).

The average values of serum iron during I trimester (Table 2) were 47.63 ± 0.83 and 36.87 ± 0.80 µg/dl among the pregnant women in E and C groups respectively. The corresponding levels during III trimester were 51.93 ± 1.13 and 38.27 ± 0.94 µg/dl, respectively. Statistical difference ($P \leq 0.01$) in the values of serum iron was also reported in the E group during III trimester. The observed levels in the present study were below the normal range of 65-75 µg/dl as suggested by Dutta (1988), indicating iron deficiency anaemia among the subjects. The values of TIBC observed in the present study confirm their anaemic status in both E and C groups, but the condition was worse in C group. Other studies conducted by Vijayalakshmi and Usha (1981) and Canto et al. (1979) reported that in the treated women, Hb and serum iron values were higher towards the end of pregnancy as compared to the untreated group. The mean serum calcium levels during I trimester was almost similar in both the groups (Table 2) but during III trimester, the improvement in the levels was observed only in case of E group. It may be attributed to the regular intake of one calcium Sandoz tablet/day starting from II trimester onwards till the delivery among the subjects in E groups. A statistically high significant difference ($P \leq 0.01$) was observed between the two groups. NIN (1984) reported that those pregnant women who did not get any type of calcium supplement during gestation had lower serum calcium values (<9.0 g/dl).

Table 2 : Serum mineral levels of the pregnant women

Blood	*I trimester*		*III trimester*		*Normal value*
	Experimental	*Control*	*Experimental*	*Control*	
	Average ± SE (CV %)	*Average ± SE (CV %)*	*Average ± SE (CV %)*	*Average ± SE (CV %)*	
Serum Iron, µg/dl	47.6 ± 0.08 (20.1)	36.9 ± 0.0 (19.0)	51.9 ± 1.1 (16.2)	38.27 ± 0.94 (23.2)	65-75[1]
Serum calcium, mg/dl	8.93 ± 0.04 (3.9)	8.89 ± 0.05 (5.2)	9.45 ± 0.02 (3.3)	8.87 ± 0.03 (4.5)	9.11[2]
Serum zinc, µg/dl	72.8 ± 0.08 (16.2)	71.8 ± 0.07 (17.3)	69.5 ± 0.07 (12.76)	61.3 ± 0.067 (13.0)	
Serum copper, µg/dl	72.6 ± 0.2 (16.2)	71.2 ± 0.16 (17.3)	92.9 ± 0.14 (12.76)	82.2 ± -0.18 (13.0)	
Serum manganese, µg/dl	0.73 ± 0.04 (6.6)	0.68 ± 0.05 (6.7)	0.83 ± 0.03 (7.7)	0.76 ± 0.01 (7.9)	

1 Dutta (1988) 2 Roberts et al. (1973)

II. Biochemical Assessment of the New-borns

As evident from table 3 the average Hb was 14.75 ± 0.08 and 13.84 ± 0.12 g/dl in the cord blood of new-borns belonging to E and C groups respectively. The Hb levels in the new-borns belonging to E group was significantly ($P \leq 0.01$) higher as compared to the C group. It was also observed that the mothers belonging to the E group too had significantly ($P \leq 0.01$) higher Hb values as compared to the C group. The mean Hb levels in the two groups were less than the suggested normal range of 18-20 g/dl as suggested by Canto et al. (1979). As observed from table 3 and 4 the values reported for HCT, RBC, per cent transferrin saturation, serum minerals were statistically highly significant ($P \leq 0.01$) between the two groups.

Table 3 : Haemopoetic indices of the cord blood

Haemopoetic Indices	*Cord Blood*			
	Experimental (n=30)		*Control (n=30)*	
	Average±SE	*CV (%)*	*Average±SE*	*CV (%)*
Haemoglobin, g/dl	14.75±0.08	7.4	13.84±0.12	7.9
Haematocrit, %	45.98±0.28	8.7	40.60±0.21	8.9
Red Blood Cell count x10^6 mm^3	4.7±0.09	10.8	4.2±0.06	10.9
MCHC, %	31.42±0.09	11.4	32.41±0.24	0.12
MCV, u^3	97.5±0.8	8.3	96.3±0.9	8.6
MCH, pg	31.97±0.2	8.7	32.4±0.2	8.9
Serum Iron, µg/dl	120.35±2.0	26.2	108.68±2.5	29.4
TIBC, µg/dl	310±1.98	7.62	343±2.495	8.2
UIBC, µg/dl	192±2.7	8.3	230±3.7	8.3
Transferrin saturation,%	34.7±1.0	11.2	31.6±1.5	12.3

Table 4 : Serum mineral levels of the cord blood

Serum	*Cord Blood*			
	Experimental (n=30)		*Control (n=30)*	
	Average±SE	*CV (%)*	*Average±SE*	*CV (%)*
Iron, µg/dl	120.3±2.02	26.21	108.7±2.5	29.4
Calcium, mg/dl	9.5±0.66	3.9	8.97±0.09	4.90
Zinc, µg/dl	110.3±0.09	8.40	108.9±0.12	8.92
Copper, µg/dl	20.1±0.38	18.01	17.70±0.41	20.10
Manganese, µg/dl	1.63±0.04	5.92	1.61±0.07	6.92

According to the study conducted by Cockburn et al. (1980) the infants born to the mothers receiving the supplements had higher calcium and a lower incidence of hypoc- alcaemia than infants of the C women.

Many studies conducted earlier by Aggarwal et al. (1990), Ahmed (1984) and Khan (1985) have also reported that iron status of the newborns was related directly to iron status of mothers.

III. Inter-relationships Between Haemopoetic Indices of Maternal and Cord Blood

Highly significant ($P \leq 0.01$) positive correlations were observed between various haemopoetic indices of the maternal and cord blood. The highest positive significant ($P \leq 0.01$) coefficient of correlation was obtained for maternal Hb *vs* cord serum Cu levels, the value of 'r' being 0.93. This was followed by a strong correlation between maternal and cord Hb ($r = 0.83$). A positive and significant ($P \leq 0.01$) correlation between maternal and cord blood Hb was also reported by Prual et al. (1988) and Yepez et al. (1987). It was further added that iron indices in maternal blood were correlated significantly ($P \leq 0.01$) to cord iron status. A highest positive significant ($P \leq 0.01$) value of coefficient of correlation was also obtained between maternal calcium *vs* cord calcium, the value of 'r' being 0.92. Similar results have also been reported by Cockburn et al. (1980) that the cord blood calcium was correlated with corresponding maternal values.

IV. Medical Supervision and Use of Nutritional Supplements

None of the subjects in both the groups went to the doctor for medical check-up during I trimester. During II and III trimester 100% of the subjects in the E group visited SHC for medical check up. On the other hand, 33% of the subjects in the C group did not visit the SHC even once during their whole of gestation period. The observations revealed that all the subjects in the E group had taken one tablet each of folifer and calcium from 5th month onwards regularly. In case of C group only 47% of the subjects consumed folifer tablets

during III trimester, of whom only 30 per cent took them regularly. It was also observed that none of the subjects in the C group took calcium tablets as these were not supplied free of cost in the SHC.

V. Nutrition Counselling

The nutrient needs during pregnancy were reinforced by four individual and three group contacts. It was observed that nutrition counselling resulted in regular visit to the doctor for antenatal check up and getting themselves vaccinated against Tetanus during II and III trimesters on their own. These subjects too, took medicinal iron, folic acid and calcium tablets regularly. None of the subjects in the C group visited doctor for their antenatal check up during I and II trimesters. Further, 33 per cent of the subjects in the C group did not visit the doctor even once during III trimester for their check up. These subjects even did not take medicinal iron and folic acid tablets supplied free of cost in the SHC.

The results of the present study revealed that there was wide prevalence of iron deficiency anaemia among the subjects. The blood picture in the C group was however very poor during both the trimesters. There was however, an improvement in the Hb levels in the E group during III trimester in spite of haemodilution. The increased requirement of iron during this period was met through nutritional supplements. The TIBC and UIBC levels were higher in the C group but those values of HCT, RBC count, per cent transferrin saturation and serum iron were low confirming comparatively severe iron deficiency anaemia in the C group during III trimester. In spite of the regular intake of iron, folic acid and calcium tablets, all the hemopoetic indices were lower than the normal values in the E group due to poor prepregnancy status. All the haemopoetic indices of the cord blood in the newborns in the E group were significantly ($P \leq 0.01$) higher than in the C group, due to better status of the pregnant women during III trimester in the E group. The present findings revealed that nutrition knowledge along with medical supervision and effective intake of nutritional supplements were likely to result in better nutriture of pregnant women and obstetric outcome.

RECOMMENDATIONS

Training for self-employment should be encouraged in the rural women, so that their economic level is raised and they can afford food in adequate quantity of good quality and better obstetric outcome can be achieved.

REFERENCES

Aggarwal, K.N. : Functional consequences of nutritional anaemia, Published in Abstracts of the *Proc. Nutr. Soc. Silver Jubilee Celebrations at NIN*. **SL-2**: 4 (1990).

Agarwal, R.M.I., Tripathi, A.M. and Aggarwal, K.N. : Neonatal hematological values in maternal anaemia. *Ind. Pediatr.*, **20**: 369-372 (1983).

Ahmed, S. and Ashfaq, Y. : Anaemia in pregnancy. *Pakistan J. Med. Res.*, **23**: 80-83 (1984).

Anon. *Statistical Abstract of Punjab* issued by the Economic Advisor to Govt. Punjab, Chandigarh, Government of Punjab, India, 54-102 (1987).

Canto Dec, T.E., Cotina, M.J.A., Royos, D. and Viverose, A. : Haematological effects of Ferrous sulphate associated with folic acid and vit B12 in pregnant women with anaemia. *Investigation Media International*, **6**: 145-151 (1979).

Cockburn, F., Berton, M.R., Purvis, R.J. and Pocock, S.J. : Maternal vit D intakes and mineral metabolism in mothers and their newborn infants. *Br. Med. J.*, **281**: 11-14 (1980).

Dutta, D.C. *Text Book of Obstetrics*. New Central Bood Agency, Calcutta (1988).

Fattah, M.A.E., Gabrial, G.N., Shalaby, S.M. and Morcos, S.R. : A study on osteomalacia among pregnant women in Egypt. *Zeikschrift tiio Ernahrung Swissenschaft*, **17**: 140-144 *Cited Nut. Abst Rev.* 1979, **49**: 265 (1978).

Gopalan, C. : Combating undernutrition : Basic issues and practical approaches. Nutrition Foundation of India. *Special Publication Ser. No.*, **3** p. 292-294 (1985).

Khan, M.U. : Influence of mothers haemoglobin level and weight on newborn's haemoglobin level and weight. *Nutr. Rep. Internat.*, **32**: 1081-1087 (1985).

NIN. : *Annual Report*. National Institute of Nutrition, ICMR, Hyderabad. p 96-143 (1983-84).

Omotunde, O.O. and Akinyele, I.O. : Plasma calcium, phosphorus and magnesium status of selected adoles-

cent females in Ibadan. *Nutr. Rep. Internat.*, **31**: 1023-1031 (1985).

Piper C.S. : *Soil and Plant Analysis*. Inter Science Publications Inc. New York (1950).

Pitkin, M.R. : Calcium metabolism in pregnancy. *Am. J. Obst. Gynec.*, **121**: 724-735 (1975).

Prual, A., Galan, P., Berris, L.D.E. and Hercberg, S. : Evaluation of iron status in Chadran pregnant women : consequence of maternal iron deficiency on the haemopoetic status of newborns. *Tropical and Geographical Medicine*, **40**: 1-6 (1988).

Teitz, N.W. : *Fundamentals of Clinical Chemistry*, W.B. Saunders and Co. P. 928 (1976).

Vijayalakshmi, P. and Usha, V. : The impact of iron and folic acid supplementation on expectant mothers participating in modified special nutrition programme. *Ind. J. Nutr. Diete.*, **18**: 45-52 (1981).

WHO : Nutritional Anaemias. A Report of WHO Scientific Group. *Tech. Rep. Ser. No. 405* (1968).

Yepez, R., Calle, A., Galan, P., Eslenez, E., Davila, M., R., Estrella, Rs., Masse-Raimbandt, A.M. and Hercberg, S. : Iron status in Ecuadrian pregnant women living at 2000m altitude. Relationship with infant iron status. Internat. *J. Vit. Nutr. Res.*, **57**: 327-332 (1987).