A Comparative Study on Serum Level of Iron, Transferrin during Pregnancy and Post-Partum Period

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Abstracts: Backgrounds and Objectives: Although anaemia has the highest prevalence during Pregnancy, it is common throughout the reproductive cycle. Our study presents a composite picture of haemoglobin (Hb), serum level of iron (SI), total iron binding capacity (TIBC) and percentage iron saturation of transferrin in women during different trimesters of pregnancy and postpartum period. **Material and Method:** Our study was performed on a total of 100 subjects. 20 from each trimester and 15 post-partal were studied and compared with 25 non-pregnant normal subjects (controls) with age-group between 16-40 years. **Results and Interpretation:** We observed throughout pregnancy signs of increased iron demand, increased iron turnover and iron deficiency. They were demonstrated by decrease in haemoglobin. serum iron, percentage iron saturation of transferrin and increased TIBC. **Conclusion:** Thus, serum iron and total iron binding capacity are the good indices for determining the iron status and they provide us an opportunity to replenish iron stores of the pregnant mother at an earlier date thus preventing iron deficiency anaemia. [Patel K NJIRM 2014; 5(6):34-38]

Key Words: Pregnancy, Postpartum, Haemoglobin, SI, TIBC, Percentage iron saturation of transferrin

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Introduction: Iron is an essential mineral to man. It is necessary for the synthesis of haemoglobin and myoglobin as well as for the function of many vital iron-dependent enzymes. Iron deficiency is one of the commonest nutritional deficiencies worldwide and is the main cause of anaemia in children and women of reproductive age[1,2,3] . Nutritional status of mothers of child bearing age has been used as the health status indicator in such women by WHO,[4] in evaluating progress towards attainment of health for all. Iron is an important nutritional constitutent. In women of reproductive age, iron deficiency, even in the absence of iron deficiency anaemia (IDA) reduces cognitive ability and physical performance.[5,6] A large number of women in our country enter pregnancy with inadequate iron store and some develop progressive anaemia during its progress. In developing countries iron stores are depleted in approximately one third to one half of parturients, due mainly to the greatly increased iron requirement in pregnancy and insufficient iron supplementation. During pregnancy the fetus requires large quantities of iron and obtains these supplies from the mother, whether her iron stores are normal or deficient. It is especially important to recognise latent iron deficiency during pregnancy to prevent anaemia. In pregnant women, an adequate iron status is important to ensure an uncomplicated pregnancy as well as a normal development of the foetus and maturity of the new-born child.[7,8,9]

In the developing countries, iron deficiency and IDA is far more prevalent than in the Western societies and constitutes a major health problem among women of reproductive age and pregnant women.[1] During pregnancy the physiologic need for iron is extraordinary high. In women of reproductive age, the requirement for absorbed iron is on the average 0.8 mg/day. The average requirements for absorbed iron increase steadily during pregnancy from 0.8 mg/day in early first trimester to 7.5 mg/day in the third trimester. The average requirement for absorbed iron in the entire gestation period is ~4.4 mg/day. [7]

Apparently women do not make major changes in their dietary habits when they become pregnant. Dietary iron consists of heme iron and non-heme iron, of which heme iron has the highest bioavailability. The major fraction of dietary iron, ~90% is non-heme iron, which in the average indian diet has a bioavailability less than 10-15%, depending on the amount of meat, fish and poultry in the diet. This means that dietary iron absorption in pregnant women is approximately 1.0-1.4 mg/day, which is far below the requirements during pregnancy.[7] The haemoglobin concentration is often used as a pseudomarker for iron

deficiency. However, haemoglobin is not suitable to assess iron status – especially not in pregnancy due to hypervolaemia and haemodilution.[1,2] Haemoglobin yields information about the presence of anemia in general and IDA in specific when body iron reserves are depleted. Conventional methods to diagnose anaemia are not adequate with their inherent limitations. It was anticipated that measurements of Serum Iron, Total iron binding capacity and Percent iron saturation of transferrin during different trimesters of pregnancy and postpartum period, would reflect the iron needs of the pregnant women and contribute to an understanding of the nature of physiological anaemia in pregnancy.

Material and Methods: The study was conducted on 100 cases after obtaining permission from Institutional Ethics Committee. The subjects, enrolled for the study were informed about the study and procedural details and an informed consent was obtained. Sixty adult pregnant women at different periods of gestation, another fifteen during their postpartum period and twenty five normal non pregnant were the subjects of study. They were selected from antenatal clinic at random on the basis of their apparent health.20 patients of each trimesters were randomly selected and their blood parameters were carried out. The age of the subjects ranged from 16 to 40 years. Fifteen puerperal subjects were selected similarly from postnatal wards of the civil hospital, Ahmedabad. The normal non-pregnant women were chosen of the matching age group from the college staff to act as controls. The informed written consent was obtained from all subjects.

All samples were collected in the morning between 10AM to 12 noon to avoid low values later in the day due to normal diurnal variation. From each subjects 10 ml blood was collected from an ante-cubital vein with whole glass, iron free sterile syringe in test tubes, thoroughly cleaned by boiling in iron free double glass distilled water and following investigations were done:

1) Estimation of haemoglobin by Cyan methaemoglobin method.
2) Serum iron estimation.
3) Iron binding capacity of serum.

Estimation of SI and TIBC was done as per procedures recommended for the Iron Panel of the International Committee for Standardisation in Haematology and published as reference method. These methods have been devised after inter laboratory testing of the variables, and presented accuracy and reproducibility.

4) The percent iron saturation of transferrin
Was then calculated by following formula:

Serum Iron and Transferrin in Pregnancy =
$$\frac{SI \times 100}{TIBC}$$

Statistical Analysis: Data was expressed as mean value ± standard deviation and comparisons between the three groups were performed using one-way analysis of variance (ANOVA), and unpaired t test was used for comparisons between two groups.

Result:

Table 1: Hb, SI, TIBC, Percent Iron Saturation Of Transferrin At Different Periods Of Gestation

Parameters	Normal	Pregnancy (trimester)			Post - partum
		1st	2nd	3rd	
No.of subjects	N=25	N=20	N=20	N=20	N=15
Hb (gm/dl)	11.15 ± 1.12	10.75 ± 1.19	10.26 ± 1.22	10.14 ± 1.02	9.56 ± 0.80**
Serum iron (mcg/dl)	109 ± 22.15	97 ± 11.96	91.26 ± 17.82**	89.73 ± 14.01**	98 ± 25.70
TIBC (mcg/dl)	287.8± 37.13	295.20± 40.09	360.05 ± 49.86**	421.8 ± 54.20**	466.15 ± 64.10*
Percent iron saturation oftransferrin.	35.20 ± 8.95	32 ±7.02	22.87 ± 5.89**	19.03 ± 5.76**	21± 6.24**

**Highly significant

Table 2: Hb, SI, TIBC, Percent Iron Saturation of Transferrin In Different Age Groups

Parameters	16-20 yrs	21-25 yrs	26-30 yrs	31-35 yrs	36-40 yrs
No.of subjects	N=15	N=24	N=28	N=19	N=14
Hb (gm/dl)	10.27 ± 1.07	10.56 ± 1.62**	9.93 ± 1.54	9.69 ± 0.96	9.05± 1.02
Serum iron (mcg/dl)	90.14 ± 20.44	97.17 ± 21.86	90.15 ± 17.40	76.84 ± 15.26"	82.43± 21.90
TIBC (mcg/dl)	382 ± 90.04	386 ± 58.04	386.50 ± 80.11	389.43 ± 69.04	390± 72.21**
Percent iron saturation oftransferrin.	26.06 ± 9.47	25.45 ± 6.12	24 ± 8.23	22.90 ± 6.11	22.56± 7.04**

**Highly significant

Haemoglobin: Our study shows that there was continuous decrease in the mean level of Hb throughout pregnancy, which was not statistically significant in various trimesters as compared to normal, but decrease in haemoglobin was highly significant in postpartal group when compared to normal control group. The mean Hb level continuously decreased in age group 31-35 years and 36-40 years though not significantly (Table II).

Serum iron: There was continuous decrease in mean SI level throughout pregnancy which was highly significant in II and III trimester. There was highly significant rise in postpartal period though it was still lower than the normal levels (Table I). No correlation between SI level and age was demonstrated (Table II)

Total iron binding capacity: There was a continuous increase in mean TIBC level throughout pregnancy and postpartum period. This rise was not significant in Ist trimester, but very highly significant in II and III trimesters and postpartal period (TableI). Table II shows no significant relationship in TIBC mean levels in different age groups.

Percent iron saturation of transferrin showed a continuous significant decrease throughout pregnancy and postpartum period (Table I). It decreased insignificantly with increase in age (Table II)

Discussion: Mothers in developing countries often embark on pregnancy with low iron and other nutritional stores through the combined effects of inadequate nutrition and a cycle of pregnancy and lactation in their childbearing years.[13,14,15,16] The decline in mean levels of haemoglobin throughout pregnancy have been reported.[13,14] The majority of women in our country enter pregnancy with already decreased levels of haemoglobin. Legacy of poor iron stores at birth from an iron deficient mother, demands of growth, onset of menses and inadequate diet may be important causes.[15,16]

The haemoglobin levels do not rise during pregnancy, not only because newly formed haemoglobin is added to comparatively large volume of plasma, but also due either to inability to take iron supplement or irregular intake of the same. In postpartum period, due to blood loss, haemoglobin levels are further lowered. Same factors contribute to decrease in haemoglobin with age [15,16]. The serum iron levels also decrease throughout pregnancy. Mothers in developing countries traditionally tend to have several children close together in the early years of marriage, and to space pregnancies later, many relying on the contraceptive properties of breastfeeding.[8,9]

During 1st trimester maternal iron stores are mobilised to compensate the demand by the fetus. These fetal demands further increase during II trimester. Increase in erythrocyte mass is a feature of mid-pregnancy . In the presence of increased erythropoietin placental lactogen stimulates erythropoietin directly and maximally 3. Slight rise in SI level in postpartal period may be due to shrinkage of plasma volume, absence of fetal demand and supplementation of iron to the mother[16]. The greater rise of plasma volume in multigravidae as compared with primigravidae also contributes to low Serum iron in multigravidae. Also in multigravid women each following pregnancy further draws upon already negative iron stores of the mother. Total iron binding capacity of the serum rise significantly during pregnancy, against the gradient of dilution, which is an expression of the vastly increased turnover of iron in late pregnancy. TIBC is influenced by subject's iron and endocrine status.

TIBC increases during pregnancy to the extent of 15% above nonpregnant level.[3,14] This is apparently secondary to sex hormonal influence. All these factors contribute to a sort of iron hunger.

The transferrin not bound to iron, is readily available resulting in increased TIBC. These findings are consistent with those reported by other authors [9,15,18,19,20]. Percent iron saturation of transferrin is significantly decreased, due to decrease in Serum iron levels and increase in Total iron binding capacity levels in various trimesters of the pregnancy [9,19]. Kurhade et al also suggest that haemoglobin, erythrocyte morphology may take longer to suggest hypochromic microcytic anaemia, fall in SI preceeds them.[9,19,20] This associated with TIBC and percent iron saturation of transferrin would form a group of more sensitive tests. A short birth interval may jeopardise the pregnancy and compromise recovery and replenishment of maternal stores. Anemic mothers in our study had a lower hematocrit at "booking" than controls, suggesting a compromised nutritional status early in pregnancy. Low hemoglobin and plasma ferritin values persisted at 6 months postpartum. The results are analysed to identify the extent and gravity of problem. The study suggests that although situation is improving, there is a long way to go to achieve WHO's goal of Health for All.[21]

Conclusion: Our present study conclude that serum iron ,total iron binding capacity and percent iron saturation of transferrin are the indicators of iron status during pregnancy and postpartum period.

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