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# Serum Iron Estimation in Women During the Course of Gestation and Lactation by Atomic Absorption Spectrometry

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**Abstract:** A comparative study was carried out to develop a relationship between serum iron level of pregnant and lactating women with their ages, number of births, pregnancy/lactating periods and dietary iron intake over a period of eight months. The results showed that mean serum iron level of nursing mothers was higher than pregnant women. Formers consumed higher percentage of dietary iron (61% of the RDA) than latters (53% of the RDA). In both cases age had positive correlation with serum iron level. Number of births and pregnancy/lactating periods contributed significantly to the development of iron complications in both cases either independently or dependently. By unraveling the other frontiers like dietary habits, life styles, patterns of cooking, bioavailability of iron, social services and environmental factors, a proactive food chart can be developed that will be helpful to keep away IDA from women and newborns in future.

**Key words:** Estimation, serum iron, pregnant and lactating women

## INTRODUCTION

Anemia is a condition in which the number of red blood cells, the concentration of hemoglobin (Hb) or the hematocrit is below normal (Diejomaeoh *et al.,* 1999). The WHO definition for diagnosis of anemia in pregnancy is a Hb level less than 11 g $dL^{-1}$, although CDC (Center for Disease Control, USA) proposes a cut off point of 10.5 g $dL^{-1}$ during second trimester (WHO, 1972). Among other anemias, Iron Deficiency Anemia (IDA) is the most common worldwide. Its cause can be long term blood loss, low intake of iron/faulty iron absorption. If iron is not available to make erythrocytes, a hypochromic microcytic anemia develops (Viteri, 1994). Usually, in dietary sources it is found mainly in two forms, heme and non-heme iron. Former includes all foods that contain iron in heme form such as animal blood, flesh and viscera while latter is present in cereals, vegetables, milk and eggs (Hulten *et al*., 1995). The absorption of iron in normal women is 15-30% and can increase to 50% in case of pregnancy. Its absorption can be enhanced by proteins, vitamins C and retarded by phytates, calcium, fibers, coffee, tea, herbal infusion and chocolate (Hallberg and Bjorn-Rasmussen, 1972). The man and woman require 10 mg and 15 mg of iron per day respectively. Iron is the only nutrient for which normal adult woman has a greater RDA (Required Dietry Allowances) than man (Stoltzfus and Dreyfuss, 1998).

Iron nutritional status depends upon long term iron imbalance that is favoured by ingestion of adequate amounts of iron fortified diet and supplementation in the form of tables (Viteri, 1994). The balance is strongly affected by the loss of iron due to excretion, skin desquamation, menstruation, gestation, lactation, worm infestation, ulceration and other occult blood loss (Bothwell *et al*., 1979). Besides iron supplementation, eating non- heme iron along with vitamin C helps to increase its absorption (Hallberg and Bjorn-Rasmussen, 1972). The severe IDA in pregnancy may lead to preterm delivery, maternal complications and also increased risk of death of the offsprings in the first week of gestation (Sharma, 1998). In most developing countries, including Subcontinent about half of children and women of childbearing age are suffering from IDA which is responsible for 40-60% maternal deaths (Bhatt, 1997). Iron toxicity causes over absorption and high accumulation of it develops haemosidrosis, cirrhosis of liver, pancreatic diabetes and heart failure. Moreover, its excess in body is associated with certain types of cancer (Sharma, 1998).

The aim of the present study was to evaluate the iron status in pregnant and lactating women and also develop a relationship of iron levels in both cases with their ages, number of births, pregnancy/lactating periods and dietary iron intakes. Furthermore, this will provide a guideline for fortification Programme used by public health personals for the eradication of IDA in the region.

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## MATERIALS AND METHODS

The study was conducted in the Department of Chemistry, University of Azad Jammu and Kashmir Muzaffarabad during 2003-2004. A total of 100 subjects; 20 normals, 40 pregnant and 40 lactating women were selected randomly for the estimation of their serum iron level. Pregnant and lactating mothers were referred as cases.

**Sample preparation and determination of serum iron:** The serum iron was estimated by the method of Subramanian (1987). The blood taken with a sterilized syringe was allowed to clot and subsequently centrifuged for 15 min at 900 rpm to separate the serum. In 2 mL serum, nitric acid (1 mL) and hydrochloric acid (4 mL) were added and made up the volume with de-ionized water in 10 mL measuring flask. The samples were analyzed by employing AAS (Thermo Electrical UK).

**Determination of dietary iron:** The food regarding to pregnant and lactating women were collected during breakfast, lunch and dinner on the spot without prior information on different days. The foods were dried in an oven (at 100°C) for 2-3 h. For estimating the iron, 1g of ground food material was ignited in a muffle furnace at 500°C until a white ash was obtained and weight became constant. The ash obtained from 1g of powdered food was digested in aqua regia and heated up to dryness. The residues were dissolved in 10 mL conc. $HNO_3$ and heated carefully until the solutions turned colorless, transferred into the measuring flasks ( 50 mL ) separately and volumes were made up to marks by adding deionised water. Estimation of iron in each sample was carried out by following the method of Ahmad and Manan (1990).

## RESULTS AND DISCUSSION

The range of serum iron level in normal women was found to be 60-180 μg $dL^{-1}$ (Table 1). This is in close agreement with the results reported previously (Annino and Giese, 1976). The mean value of normals' serum iron was 123.31±43.37 μg $dL^{-1}$ while in case of pregnant and lactating women mean serum iron concentration was 97.13±44.49 and 99.28±-38.68 μg $dL^{-1}$, respectively. The difference is statistically significant however, latter require iron supplementation when the diet doses not compensate daily loss of it (Ganong *et al*., 1991). Table 3, shows that the lactating mothers had higher serum iron (mean value) than pregnant women. Traditionally, majority of women eat millet products just after births which contains 8 mg iron per 100 g (Passmore, 1976). Moreover, the higher percentage (27.5%) of pregnant women was found to have serum iron level below normal range than nursing mothers (15%). In gestational period fetus causes the depletion of iron store from mothers (Arlin, 1977). Present results are little bit different from the values reported by Muhammad (1997). The minor variations depend upon nutrition, dietary habits, social services and environmental factors of the region (Sharma, 1998). Table 3 shows, that in case of pregnant women the relationship of gestational period and number of births with their serum iron concentration is linear over a broad range of its value. In nursing mothers, on the other hand, indicates that there is strong inverse correlation between lactating period and number of births whereas positive correlation exists between serum iron concentration and age in each case. This means that blood serum iron retention and age increases simultaneously. This commensurates exactly with the results reported by Muhammad (1997).

Table 1: Serum iron level by age in normal women

| Serum iron level (μg $dL^{-1}$) | 20-30 years | 30-40 years | 40-50 years | Total |
|---|---|---|---|---|
| 60-80 | 01 | - | 01 | 02 |
| 80-100 | - | 01 | - | 01 |
| 100-120 | 02 | 03 | - | 05 |
| 120-140 | 03 | - | - | 03 |
| 140-160 | 03 | 02 | 02 | 07 |
| 160-180 | 02 | - | - | 02 |
| Total | 11 | 06 | 03 | 20 |

Overall mean±SD 123.31±43.37 μg $dL^{-1}$

Table 2: Status of iron in different foods and its average intake by women

| | Iron (mg/100 g)* | During breakfast lunch and dinner | Percent intake/day (mg) | Intake of diet group RDA (%) | Absorption by gut (%) |
|---|---|---|---|---|---|
| Wheat (chapatti) | 1.45±0.10 | | | | |
| Pulses | 2.20±0.53 | Pregnant | 16.00 | 47 below | 55 |
| Meats | 2.53±0.12 | | | | |
| Vegetables | 2.00±0.30 | | | | |
| Rice | 1.41±0.43 | Lactating | 18.34 | 39 below | 59 |

*Values are based on the average of three determinations.

Regarding nutrition, the average contribution of iron from various food components is given in Table 2. The data show highest amount of iron in meats, 2.53±0.12 mg/100 g and lowest in rice (1.41±0.43 mg/100 g). The concentration of iron in wheat, pulses and vegetables was 1.45±0.10, 2.20±0.53 and 2.00±0.30 mg/100g, respectively. This indicates that lactating women consume more iron (18.34 mg) than pregnant mothers (16 mg) per day through diet. These findings are little bit different from the previous results (Islam *et al*., 2001) and congruent with the values of Kapil and Pathak (2003). According to Wardlaw and Insel (1995), the iron absorption by gastrointestinal tract depends upon its dietary intakes. In light of these data it can be said that breastfeeding mother has higher capacity of dietary iron absorption (59%) from the gut than pregnant one.

Table 3: Relationship of serum iron levels of women with their pregnancy/lactating periods, number of births and ages

| Women group | Mean serum iron level (mg $dL^{-1}$) | Average No. of birth | Average pregnancy/ lactating period | Average age | Correlation between pregnancy/ lactating period and Iron level | Correlation between No. of births and serum iron level | Correlation between age and serum iron level |
|---|---|---|---|---|---|---|---|
| Pregnant (40) | 97.13±44.49 | 2.25±2.10 | 6.0±3.13 | 29.64±7.91 | 0.025 | 0.32 | 0.40 |
| Lactating (40) | 99.28±38.68 | 2.72±2.58 | 4.33±2.5 | 27.66±5.61 | -0.0015 | -0.107 | 0.26 |

Results are based on triplicate measurements.

In Pakistan, particularly in Azad Jammu and Kashmir no study has been done to assess the importance of the balanced dietary iron consumption among different women groups so far. The factors and resources responsible to develop IDA such as dietary habits, life styles, meal patterns, method of cooking, social services, bioavailability of food iron and environmental factors need to be studied carefully. However, it can be concluded that serum iron level in both cases (pregnant and lactating women) is significantly affected by dietary iron intakes. Other parameters like age, number of births and lactating/gestational periods have their contributions in developing iron complications in one way or the others. These are either independent of each other or dependent upon one another having inverse relation. This study also suggests that there is less need of iron supplementation for nursing mothers as compare to pregnant women in Muzaffarabad, Azad Kashmir. Moreover, it is likely that our results will become a base line reference value for the future study.

## REFERENCES


Ahmad, I. and F. Manan, 1990. Determination of Iron. Biol. Anal. Chem. 2nd Edn., pp: 100-101.

Annino, J.S. and R.W. Giese, 1976. Iron. In: Clinical Chemistry: Principles and Procedures. 4th Edn., Little and Brown, Boston, pp: 329-32.

Arlin, M., 1977. The Essence of Nutrition in Pregnancy and Lactation. 2nd Edn., Macmillan Publishing Co., Inc., New York, pp: 233-335.

Bhatt, R., 1997. Maternal mortality in India-POGSI-WHO study. J. Obstet. Gynacol. Ind., pp: 207-214.

Bothwell, T.H., R.W. Charlton, J.D. Cook and C.A. Finch, 1979. Iron Metabolism in Man. Oxford: Blackwell.

Diejomaeoh, F.M.E., A.A. Abdul and A.D. Adekile, 1999. Anemia in pregnancy. Intl. J. Gynecol. Obstet., 65: 299-301.

Ganong, W.F., M.D. Jack and D. Lange, 1991. Energy Balance, Metabolism and Nutrition, In: Human Physiology. 15th Edn., Appleton and Lange, California, pp: 293.

Hallberg, L. and E. Bjorn-Rasmussen, 1972. Determination of iron absorption from whole diet, a new two-pool model using two radiation isotopes given as haem and non-haem iron. Scand J. Haematol., 9: 193-197.

Hulten, L.E., A. Gramatkovski and L. Hallberg, 1995. Iron absorption from the whole diet. Relation to meal composition, iron requirements and stores. Eur. J. Clin. Nutr., 49: 794-808.

Islam, M.Z., A.C. Lamberg, M.A. Bhuyan and Q. Salamatulla, 2001. Iron status of women in Banglaladesh. Eur. J. Nutr., 55: 598-604.

Kapil, U. and P. Pathak, 2003. Concomitant prevalence of multiple micronutrient deficiencies among pregnant and non- pregnant women in a rural block of Haryana State, India. All India Institute of Medical Sciences, New Dehli 110 029, India.

Muhammad, S.S., 1997. Serum iron levels in pregnant and lactating women in Kano, Nigeria. Hamdard J., 3: 80-82.

Passmore, J.B., 1976. Essential Minerals and Waste in Companion to Medical Studies. 2nd Edn., Blackwell Scientific, London, 1: 58-59.

Sharma, J.B., 1998. Medical Complications in Pregnancy. In: Sharma, J.B. (Ed.). The Obstetric Protocol, Delhi: Jaypee Brothers, pp: 78-98.

Stoltzfus, R. and M.L. Dreyfuss, 1998. Guidelines for the use of iron supplements to prevent and treat iron deficiency anemia. Geneva: I NAC Co. WHO. UNICEF,

Subramanian, K.S. 1987. Determination of lead in blood comparison of two GFAAS Methods. Atomic Spectroscopy, 8: 7-11.

Viteri, F.E., 1994. The consequences of iron deficiency and anemia in pregnancy. Adv. Exp. Med. Biol., 352: 127-139.

Wardlaw, G.M. and P.M. Insel, 1995. Perspectives in Nutrition. 3rd Edn., Mosby, USA., pp: 532-534.

WHO., 1972. Report of a WHO Group of Experts on Nutritional Anemia. 1st Edn., World Health Organization, Geneva.