# Iron and The Indian Women

**Rohit V. Bhatt**
**Dept.Obst.Gynec., Bhailal Amin General Hospital, Baroda**

*Rohit V. Bhatt*

Iron deficiency is the most prevalent nutritional problem in the world today. According to WHO estimates, 500 million women in the world are suffering from iron deficiency. Nearly 60-70 percent of menstruating women are iron deficient (Arthur, and Isbister 1982). In USA, 20 percent of women are iron deficient (Linker 1994). Even in western countries, 20 percent of women are iron deficient. Iron deficiency is not only a medical problem but is a public health, social and economic problem. Diminished iron levels affect work capacity and reduce productivity because of lassitude, fatigue and reduced effeciency at work place. It is also known to impair immune system which increases the risk of developing infections. Iron deficiency anemia adversely affects reproductive performance. Maternal and perinatal mortality/morbidity, preterm births and low birth weight babies are higher in iron deficiency. The physical and mental growth of children is adversely affected. Unlike many other nutrients, body has the capacity to store iron in the body so that it could be utilized in times of emergency. The iron is mainly stored in the liver, spleen, bone marrow and RE system. The need for studying iron deficiency in India was recognized and the First National Conference on Iron Deficiency was held in Mumbai in 1968 by our renowned physician Dr.J.C.Patel. Those interested may refer to the proceedings of this conference published by B.C.Mehta and J.C.Patel (1970)

## Facts about Iron

There is about 4.5 to 5 grams of iron in the body. Red blood cells carry about 2 to 2.5 grams of iron. Tissues have about 200 mg. of iron and 3 mg. of iron is in circulation in plasma. The normal loss of iron in man is upto 1 mg. per day through exfoliation of skin mucosal cells, sweat, urine and stool. In female, the daily loss is 2-3 mg. because of menstrual blood loss. The demand is even higher during pregnancy upto 5-6 mg. per day. Haemoglobin contains 0.33 percent iron. Therefore, with 15 G.haemoglobin percent, there would be 50 mg. of iron in 100 ml. of blood. One gram of haemoglobin can combine with 1.34 ml. of oxygen. In a woman with 15 G.haemoglobin percent, the oxygen carrying capacity would be 15 x 1.34 = 20 ml. of oxygen per 100 ml. of blood. Therefore, if there is a fall in haemoglobin level, there will be corresponding reduction in oxygen carrying capacity of the blood which may result in poor tissue perfusion. The body starts storing iron from childhood and by the time the child becomes an adult, the storage iron in man is about 800-1000 mg. and in woman it is about 400-600 mg. Unfortunately, most women in India and other developing countries are not able to reach this limit. This is due to poor nutrition, menstrual blood loss, infections like hookworm and malaria and increased demand of iron in pregnancy at a younger age. Teenage pregnancy in India accounts for 12-15 percent of total births. Thus, an average Indian woman enters her first pregnancy with inadequate or poor iron stores. This is due to poor nutrition, menstrual blood loss, infections like hookworm, malaria, etc. The iron is stored as ferritin and serum ferritin reflects the status of iron stores. One

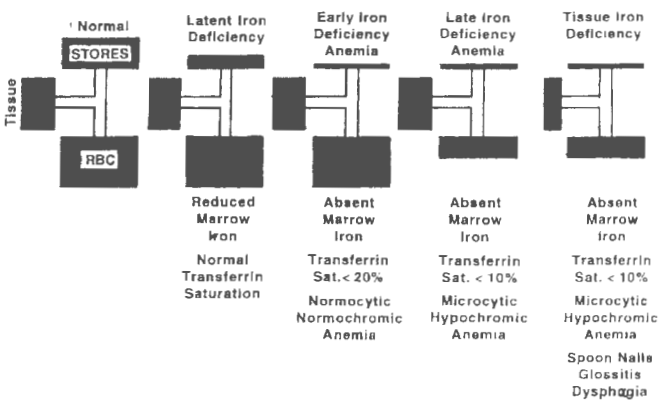
ng. of s. ferritin per ml. represents 8-10 mg. of storage iron. If s. ferritin levels fall below 20 ng/ml., it means there are minimal or no iron stores. We studied s. ferritin levels in normal healthy male resident doctors, female resident doctors, nurses and pregnant women in Baroda (Bhatt,1996). The s. ferritin below 20ng/ml. was seen in 60 percent of pregnant women, 55 percent of the nurses, 50 percent of women resident doctors and 11 percent of male resident doctors. Leela Raman(1991) in her study found that 50 percent of the pregnant women became iron deficient by the third trimester (s.ferritin less than 12ng/ml). The disparity in iron stores in Indian women is partly due to gender discrimination. The girl child in India receives less nutritious food, does more household work and there is delay in seeking medical help in sickness. Thus, an average Indian woman enters her first pregnancy with inadquate or poor iron stores. Only 50 percent of pregnant women receive antenatal care and large majority of pregnant women are denied medicinal iron. Even in those pregnant women who do seek antenatal care, the supply of iron tablets is erratic, irregular and inadequate (Preema et al, 1989). Thus, the main problem in Indian women is inadequate iron stores, lack of supply of medicinal iron and poor compliance in consuming iron tablets by Indian women. Non compliance remains a major problem in anemia control. The problem of non-compliance is not only a feature in developing countries but is also seen in the developed countries. Bonnar and Goldberg (1969) reports that one out of three pregnant women do not take oral iron as directed. World Health Organization (1990) in its report states "little attention is paid to find out the reasons for non-compliance. The pregnant women's feelings, beliefs and understanding of her own body and her perception of her own state of health influences medication utilization. The form in which the drug is administered, the colour, the taste, ec. also influence compliance rate. The WHO report concludes by saying that 'more research is needed in this area'.

## Sequence of iron Depletion

The sequence of iron depletion is very vividly shown in Figure 1. Normally the iron requirement is minimal in absence of blood loss, infection or pregnancy and dietary iron is able to maintain iron stores. However, in undernutrition, heay blood loss, infection or pregnancy, there is not enough iron stores. The iron stores release the iron when there is demand from the body. This is to maintain normal circulating haemoglobin. Iron deficiency is described in three overlapping stages, beginning as deficiency and terminating as anemia. In the first stage, stored iron is depleted reflected by declining levels of serum ferritin. In the second stage, there is fall in serum iron with corresponding rise in total iron binding capacity of the serum. In the third and final stage, synthesis of haemoglobin is inhibited and iron deficiency anemia develops. Unfortunately, iron deficiency is not detected in early stages. The haemoglobin values will fall when all iron stores are utilized. Thus fall in haemoglobin is a very late manifestation of iron deficiency. Therefore iron deficiency and iron deficiency anemia are not synonymous. Actually, fall in haemoglobin is a very late feature of iron deficiency. Special investigations are necessary to establish iron deficiency. These investigations are serum iron, total iron binding capacity of serum, serum ferritin, bone marrow studies, etc. At present, s. ferritin is considered a reliable indicator of iron deficiency though it has some fallacies. Therefore, study of blood indices like mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) along with peripheral blood smear give reasonably good indication of iron deficiency.

The value of iron in treatment of anemia and maintaining health is known since time immemorial. The Indian system of medicine recognized the value of iron in anemia

FIGURE 1
SEQUENCE OF IRON DEPLETION



and 'Loh Bhasma' (iron dust) was prepared by roasting sheets of iron and then macerating them to a fine white powder. The following are some of the historical references from Goodman & Gilman (1970). The Greek physicians also used iron for cure of weakness (a prominent symptom of anemia). The phrases like, 'Man of Steel, or 'Iron Man' amply prove the high regard for the use of iron to provide strength. Patients with pallor were given water in which old swords had been allowed to rust. Sydenham in 1832 was probably the first physician to employ iron more or less the way, we use it today. Lemery and Goeffy in 1713 showed that iron was present in blood. Menginni in 1746 demonstrated that foods rich in iron can elevate the amount of iron in blood. In 1832, Pierre Blaud, a french physician formulated the famous 'Blaud's pills' which originally consisted of ferrous sulphate and potassium carbonate. Neuroth & Lee (1941) have given a detailed review of Blaud pills.

In medicine, mortality/morbidity is more for those diseases for which either the cause or the cure is not known. It is paradoxical but true that though cause of iron deficiency is known and iron is one of the cheapest of medicines, even then iron deficiency exists in India and many other developing countries. Even some developed countries have iron deficiency in the population. What then is the way out? Iron deficiency anemia is prevalent in 70 percent of Indian women and 60-70 percent of maternal deaths are related to anemia. It is very necessary that iron deficiency is managed on war footing. We suggest following approach.

1. Building adequate iron stores in all women before they reach adulthood.
2. Provide medicinal iron to women at risk (pregnancy, menstruation and in other conditions associated with blood loss) and educate women to increase iron compliance.

## 1. Building Iron Stores

The nutritional standard of Indian woman must be improved right from infancy and childhood. Attempts must be made to halt gender discrimination in food and upbringing of children. The cooking habits need modification. They must be encouraged to consume more green vegetables, pulses and foods rich in iron. There is need for food fortification with iron. Food fortification has advantage that it requires little co-operation from the community. Widely consumed foods in the community must be selected for fortification.This may vary from country to country depending on the food habits. In USA, wheat flour is fortified with iron (13-16.5 mg. per pound of wheat flour). In UK, all manufacturers of bread are required by law to add iron supplement to the bread they sell. In Venezuela, studies are on to fortify sugar with iron (Layrise, 1976). In India, Prema (1992) reports that technology to fortify common salt with iron is developed and its effectiveness in improving irons status is demonstrated. Large scale introduction of iron fortified salt is currently being organized in the state of Tamil Nadu. The common salt or sugar appear to be a good vehicle for fortification of iron. Those of wheat flour has some limitations. The phytic acid in wheat could reduce iron absorption. Moreover, eating of prepared bread is not common. People prefer home made chapati or roti and so they grind the wheat in the flour mill. In south India, wheat is not a staple food. Rice is consumed to a great extent. Since there are wide variations in pattern of food consumption, salt and sugar appear more appropriate. Ideally, the iron stores should be replenished before the woman has her first pregnancy. Therefore, the best time for intervention is adolescence period. There is mid-day meal scheme in many schools in India. Iron tablets could be administered to all adolescent girls to build iron stores. It would be easy to administer iron tablets in schools during the mid day meal. Those girls who are not attending schools could be covered by home visits in rural areas and slums. Prevention of malaria and hookworm may reduce loss of iron.

## II. Provide Iron to all Pregnant Women and Women at Risk

Iron deficiency and poor iron stores is the normal feature in most Indian women. Therefore during all stress situations needing more iron, women must be provided

medicinal iron. Ferrous sulphate is the cheapest and well absorbed form of iron. Reducing agents such as ascorbate, succinate inositol, etc. increase iron absorption. Undesirable g.i. tract related side effects do develop in some women. This could be reduced or prevented if woman is properly informed and advised. Very high dose of iron also causes more side effets. Studies have shown that only 30-60 mg. of elemental iron is needed for prophylaxis (Iyengar and Apte, 1970). Low dose iron is well absorbed and better tolerated. If higher dose is needed in therapeutic dose, it should be built slowly giving enough time to the body system to adjust. We have advised low dose iron on alternate days for 1-2 weeks, and then gradually increasing the dose to our patients and this has significantly improved compliance to iron.

Ferrous salt of iron is better absorbed than ferric form. Iron from colloidal ferric hydroxide and iron carbohydrate complex is also poorly absorbed. The sustained release iron preparations claim reduction in side effects. The iron is mainly absorbed in the duodenum and upper jejunum. The absorption of iron will be reduced because iron is released low down in the gut. Thus, the reduction in side effects is due to reduced absorption of iron and not due to any special feature in sustained release preparations. The cost of sustained release preparations is high and hence it has no special indication over conventional iron preparations. Iron preparations with haemoglobin iron are also available. Since 1 gram of haemoglobin contain 3.4mg. of iron, most haemoglobin preparations would have 15-20 mg. iron only which is not sufficient for prophylactic or therapeutic use. In nutritional iron deficiency anemia of pregnancy, there is also lack of folic acid. Therefore, it is suggested that along with iron, 300 micrograms of folic acid should also be given. It is interesting to note that it is generally agreed that all pregnant women in developing countries need iron supplements. However, in well nourished pregnant women in developed countries, there is no need to give routine iron (Mahomed & Hytten, 1989). They further state, to treat all pregnant women as if they were iron deficient, is therapeutically misguided and possibly harmful. There is a tendency to stop iron as soon as haemoglobin values come to normal. It is not realised that oral iron therapy should be continued for 4-6 months after the haemoglobin comes to normal. This medication helps to build iron stores. If the iron therapy is not continued for 4-6 months, there is no development of iron stores and she would become again iron deficient when there is increased demand for iron as in heavy menstrual blood loss, pregnancy or malaria / hookworm infection.

Large majority of women will improve with oral iron therapy but there are some women who do not tolerate oral iron or they default in taking oral iron or there is some contraindication to oral iron (as in some g.i. tract disorders). It should be clearly appreciated that oral iron is cheap, safe and effective in most cases. Parenteral iron has a place in above mentioned situations. We have reviewed our experience with intramuscular iron (Bhatt, 1996) and total dose intravenous iron (Bhatt, 1977).

Preterm babies have poor iron stores and they would become iron deficient after 2-3 months. Breast milk is a poor source of iron. So if breast feeding alone is continued for a long time without addition of other food, these babies will develop iron deficiency. Therefore, iron supplementation may be necessary in the first year of life. Iron deficiency can jeopardise a child's physical and mental development (Nevin Scrimshaw, 1991). If a child is born to iron deficient mother, it will have poor iron reseves and is at risk of infection and poor growth. Since iron stores in fetus are developed in later weeks of pregnancy, preterm child would have little or no iron stores. Therefore, all preterm babies should be given iron after 3 months of age.

Multifaceted approach to correct iron deficiency in Indian women is needed. There is urgent need for food fortification of iron in commonly used food stuffs along with supply of iron tablets to all adolescent girls.

When the aircrafts is taking off for a long flight, series of tests are performed before announcing it as 'Air worthy'. Is it not tragic that women in developing countries are allowed to take off on a long flight for 40 weeks or 280 days without even checking if she has adequate iron stores. This requires careful thought and introspection.

Guide for further reading: Those who are interested in knowing more about iron deficiency, may refer to following publications:

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