NUTRITION AND HEALTH INFO-SHEET

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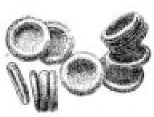
Iron and Iron Deficiency Anemia



Why is iron important?

Iron is a major component of hemoglobin that carries oxygen to all parts of the body. Iron also has a critical role within cells assisting in oxygen utilization, enzymatic systems, especially for neural development, and overall cell function everywhere in the body. Thus, iron deficiency affects all body functions, not only through anemia, which appears late in the process of tissue iron deficits.

What is iron deficiency?

Iron deficiency can exist with or without anemia. Iron is found in the body in two forms, as functional iron (iron that serves a metabolic function) and as storage iron. When a person has depleted their stores of iron, they are said to be “iron deficient.” When the depletion progresses, the hemoglobin concentration in red blood cells falls below the normal range (the 95 percentile for age). At this point, the person is classified as having anemia. Iron deficiency can exist with or without anemia (1,2).

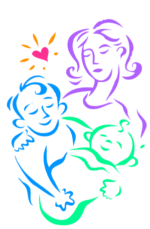
What are the consequences of iron deficiency?

The continuum from iron deficiency to iron deficiency anemia has a host of associated consequences, depending on the severity of iron depletion.

Iron deficiency, without anemia, has few discernable outcomes but it has been shown to reduce work capacity, particularly in regards to endurance. As iron deficiency progresses to anemia, further consequences become more evident including changes in behavior and intellectual performance, reduced resistance to infection, increased susceptibility to lead poisoning, loss of appetite, tachycardia, and cardiomegaly.

In young children, prolonged iron deficiency anemia has been associated with motor and cognitive deficits and an inability to concentrate. These symptoms are not always reversed with iron supplementation.

In pregnant women, iron deficiency anemia has been associated with adverse effects for both the mother and fetus, including increased perinatal complications, premature delivery, and low birth weight.



What other nutritional conditions can cause anemia (low hemoglobin levels)?

- Deficiencies of other essential nutrients such as vitamins A, C, and B_{12}, folic acid, thiamine, and pyridoxine can also cause anemia by interfering with the formation of hemoglobin.
- Adequate copper intake is needed for the transport of iron throughout the body. A copper deficiency could thus result in anemia in the body.
- A riboflavin deficiency, seen most frequently in alcoholics, can contribute to poor iron absorption and utilization, and to a decrease in the oxygen-carrying capacity of red blood cells.
- A vitamin E deficiency can impair the integrity of the red blood cell membrane and lead to hemolytic anemia.

What causes iron deficiency?

- The diet may be low in iron, and/or it may contain iron in forms that are poorly absorbed.
- Body iron stores may be low as a result of rapid growth (this is especially common in young children) or as a result of blood loss. Due to the blood losses associated with pregnancy, childbirth, and menstruation, women are particularly at risk for iron deficiency.

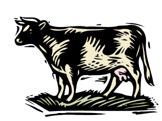
- Infants (newborns up to 12 months) fed cow's milk are more likely to develop iron deficiency than their breastfed counterparts due to several factors. Iron deficiency may result from intestinal blood loss caused by a reaction to cow's milk. A deficiency can also be attributed to the lower absorption of iron from cow's milk as compared to breast milk (10 percent vs. 50 percent). Furthermore, breastfed infants have also been shown to have larger iron stores than non-breastfed infants (1,2).
- High intakes of calcium can inhibit iron absorption if both are present in the same meal. Separating foods high in calcium from those high in iron during meals and snacks may prevent some of this calcium-induced inhibition. In many, but not all studies, calcium from both supplements and dairy products inhibited non-heme iron absorption when they were added to meals. A balanced and varied diet should overcome the effects of any such inhibition (1).

How much iron is needed each day?

Several factors influence the body's iron requirement, including iron intake, stores, and loss (3). The Recommended Dietary Allowance (RDA) for iron for all age groups of men and post-menopausal women is 8 mg/day, and the RDA for iron for pre-menopausal women is 18 mg/day. The difference in values between the two groups is primarily related to the need to replace iron losses due to menstruation. Pregnant women require even more iron, 27mg/day (2). For children of both sexes between the ages of 6 months and 11 years, the RDA is 11 mg/day.

The typical Western mixed diet can provide only about 6-7 mg of iron per 1,000 calories. Because most men consume in excess of 2,000 calories per day, it is not very difficult for them to meet their RDA through diet. Women (and younger children), on the other hand, generally eat less meat and fewer calories, and thus should be particularly careful to include iron-rich foods in their daily diet.

In what forms is iron found in the diet?



Dietary iron is found in two forms: heme and non-heme iron. Heme iron, found in red meats, fish, and poultry, is readily absorbed regardless of the other components in a meal. By contrast, non-heme iron is found in both plant and animal sources, is absorbed to a much smaller degree, and is frequently affected by other food constituents.

What are good sources of non-heme iron?

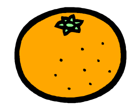
Non-heme iron accounts for more than 85 percent of the iron in the diet. Good sources of it include dried apricots, oatmeal, spinach, pine nuts, beans, and iron-fortified breads and cereals. Although the quantity of iron absorbed from breads and cereals may be low, these sources are eaten in large enough amounts that the iron found in them can be an important portion of daily intake. Other sources of iron are foods that have been cooked in iron cookware.

What affects the absorption of dietary iron?

The amount of iron absorbed by the body depends on its form in food, the body's iron stores, and other factors. Iron absorption can vary significantly from person to person and also from meal to meal: coffee or tea taken with a meal can reduce absorption by as much as 50 percent. Individuals can absorb anywhere from < 1 percent to > 50 percent of the iron in their diet.

Dietary factors that can reduce non-heme iron absorption include phytates (found in grains, legumes, and rice); soy protein and soy fiber; oxalates (found in spinach); and tannic acid (found in teas and coffee). Calcium (found in dairy products) can reduce the absorption of both non-heme and heme iron (2).

In order to maximize iron uptake, foods high in non-heme iron should be eaten at the same time as those that are a good source of vitamin C, such as orange juice, tomatoes, bell peppers, strawberries, cantaloupe, or broccoli. Absorption of non-heme iron can also be enhanced by the presence of heme iron (2). For example, a stew made with beans, tomatoes, and a small amount of meat, for example, would maximize the iron potential of both the meat and the beans.



Who is most at risk for iron deficiency?

- **Young children.** Very young children are at particular risk for iron-deficiency anemia due to their rapid growth rate. In addition, children's diets may rely heavily on milk products, which, while providing an excellent source of calcium, are not good sources of iron and can replace foods that provide iron.
- **Pregnant Women.** Because adequate intakes of iron are crucial for both the woman and her fetus, the RDA for iron during pregnancy is 27 mg/day. Iron is needed during pregnancy to replace iron lost in the course of daily activities, to allow for the needed expansion of the red blood cell mass, to provide iron to the placenta and fetal bone tissues, and to replace iron from blood lost during delivery.
- **Vegetarians.** Iron deficiency is seen more frequently in those children whose diets do not include meats (even though they may consume eggs or dairy products) as compared to omnivorous children. Care should be taken to ensure that foods containing available iron are included in the diet.
- **Women of childbearing age.** Only 25 percent of this group meet the RDA for iron (2). Small iron stores coupled with loss of iron due to menstruation place women of childbearing age at risk. The additional requirements during pregnancy make it critical for a woman to ensure sufficient iron stores prior to the pregnancy.
- **Women with high menstrual losses (menorrhagia).** Menorrhagia (>80 mL/mo) occurs in about 10 percent of women and frequently leads to iron-deficiency anemia. Women with menorrhagia are characteristically unaware of their greater-than-normal menstrual blood loss; for this reason anemia screening at the time of routine health examinations is worthwhile.

Who should be screened for iron deficiency?

Each of the high-risk groups, young children, pregnant women, vegetarians, and women of childbearing age, especially those with high menstrual losses, should be screened at the time of routine health examinations.

*How is iron deficiency anemia defined clinically?**

ANEMIA[1,3]	Hemoglobin (g/dl)	Hematocrit (percent)
Children		
1 to < 2 years	11.0	32.9
2 to < 5 years	11.2	33.0
5 to < 8 years	11.5	34.5
8 to < 12 years	11.9	35.4
Males		
12 to < 15 years	12.5	37.3
15 to < 18 years	13.3	39.7
≥18 years	13.5	39.9
Females		
12 to < 15 years	11.8	35.7
15 to < 18 years	12.0	35.9
≥18 years	12.0	35.7
Pregnancy		
1st trimester	11.0	33.0
2nd trimester	10.5	32.0
3rd trimester	11.0	33.0

*Low hemoglobin or hematocrit lists do not necessarily mean iron deficiency anemia, so this condition should be confirmed with a test for serum ferritin concentrations or a mean corpuscular volume (MCV) or erythrocyte protoporphyrin (EP) test to discriminate iron deficiency from other forms of anemia.

When are iron supplements warranted?

To prevent iron deficiency during pregnancy, the routine use of 30 mg of ferrous iron per day is recommended beginning at about week 12 of gestation, in conjunction with a well-balanced diet that contains enhancers of iron absorption. If diagnosed with iron deficiency anemia, a pregnant woman should be treated with 60-120 mg of ferrous iron daily until the hemoglobin concentration becomes normal for the stage of gestation; at this point the dosage can be decreased to 30 mg/day (3).

Iron supplements are generally recommended if a child (after six months of age) is fed a vegetarian diet or one that does not include iron-supplemented formulas or cereals.

The diagnosis of iron deficiency at any point in the life cycle warrants an examination of the diet and possible iron supplementation. Common forms include ferrous sulfate (20 percent iron by weight), ferrous gluconate (12 percent) and ferrous fumarate (32 percent). The recommended dose is dependent upon the patient's age and the severity of the deficiency. If there are gastrointestinal symptoms with a given dose, the dose can be divided or decreased. However, one dose per day has the advantage of favoring compliance. Older children can be given iron divided into 2 daily doses, ideally on an empty stomach, with water or fruit juice (not milk) to enhance absorption. Currently, there is interest in the possibility that iron supplementation once a week might be as effective for improving iron status as daily administration. This is currently being studied in pregnant women.

Can too much iron be toxic to the body?

Notwithstanding the high prevalence of iron deficiency, excessive iron intake is also a source of adverse affects. In fact, iron overdose is the leading cause of poisoning deaths in children under 6 years of age (2).

Adverse affects are usually seen with intakes between 20 and 60 mg/kg, and depending on the quantity of iron ingested, the cardiovascular system, central nervous system, kidneys, liver, and hematologic system can be affected.

References:

1 CDC Recommendations To Prevent and Control Iron Deficiency in the United States. *MMWR*; 1998.

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