

Iron: An Essential Nutrient

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Food and Nutrition Series|Health

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Iron Needs and Recommendations

Iron has many different roles in the body. About 65 to 80 percent of the body's iron is in the blood in the form of hemoglobin. Hemoglobin is a protein in red blood cells that transports oxygen to tissues in the body. Myoglobin, the compound that carries oxygen to the muscle cells, also requires iron. In addition, iron is involved in reactions within the body that produce energy. Any excess iron is stored in the body as a reserve.

If iron is lacking in the diet, iron reserves in the body are used. Once this supply is depleted the formation of hemoglobin is affected. This means the red blood cells cannot carry oxygen needed by the cells. When this happens, iron deficiency occurs and anemia results. Table 1 lists the recommended iron intakes.

Iron-deficiency Anemia

According to the World Health Organization, iron deficiency anemia is one of the most common nutrient deficiencies in the world. It can be caused by a low dietary intake of iron, poor iron absorption, or excessive blood loss. Signs of anemia include: constantly feeling weak and tired; short attention span; irritability; decreased performance at work or school; delayed cognitive development in infants and young children; decreased immune function leading to increased illness; swollen and red tongue (glossitis), and difficulty maintaining body temperature. Several groups are at an increased risk for iron deficiency including children and adolescents, pregnant women, women of child-bearing age, athletes, and older adults.

Children and Adolescents

The greatest need for iron is during growth or periods of blood loss. Young

children and adolescents have increased needs because of the growth taking place during these periods.

Pregnant and Menstruating Women

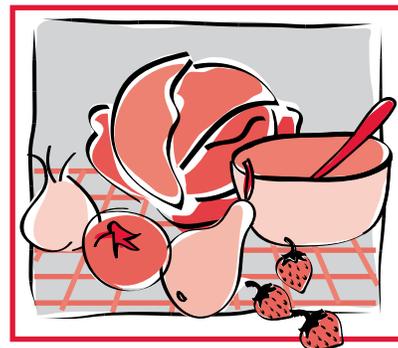
Iron needs during pregnancy are also increased due to fetal growth and increased demand for blood. Iron demands during pregnancy are so large that an iron supplement is recommended for pregnant women. Women of child-bearing age have increased requirements for iron because of the losses from menstruation (see Table 1). However, women taking oral contraceptives have slightly decreased iron needs because blood losses from menstruation tend to be less. See fact sheet number 9.323, Nutrition and Oral Contraceptives, for more information.

Athletes

An active female athlete involved in a rigorous training program has an increased risk for iron deficiency anemia. Iron deficiency is common with or without anemia, decreases performance for the athlete, and often is not detected on a standard blood test. The capacity to transport oxygen to the cells of the muscle via myoglobin is impaired (energy

Table 1: Dietary Reference Intakes (DRI) for Iron.

Age	mg iron
Infants and Children	
0-6 months	0.27
6-12 months	11
1-3 years	7
4-8 years	10
Males	
9-13 years	8
14-18 years	11
19+ years	8
Females	
9-13 years	8
14-18 years	15
19-50 years	18
51+ years	8
Pregnancy	
<18 years	27
18+ years	27
Lactation	
<18 years	10
18+ years	9



Quick Facts

- A lack of the nutrient iron in the diet may result in the development of iron deficiency anemia.
- The greatest need for iron is during growth or periods of blood loss.
- To meet dietary recommendations for iron:
 - Eat a variety of iron-rich foods and foods high in vitamin C;
 - Combine plant sources of iron with meat, fish and poultry.
- Iron absorption is affected by the iron status of the individual, the type of food eaten and vitamin C intake.

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production is limited), which is vital for competition. Male endurance athletes and vegetarian athletes may also be at an increased risk for iron deficiency. To ensure optimum iron stores, athletes should eat meals or snacks that contain adequate quantities of iron-rich foods and, in some cases, see a physician for a recommended iron supplement. See fact sheet 9.362, Nutrition for the Athlete, for more information.

Older Adults

Older adults are another group at risk for iron deficiency. Sometimes this is due to diet, but it may also be related to other complications associated with disease. Iron supplements may be necessary in some cases and should be discussed with a physician. See fact sheet 9.322, Nutrition and Aging, for more information.

To meet the recommendations for dietary iron, eat a variety of foods. Iron is highly concentrated in organ meats such as liver and heart. Most meats (especially red meats) have a high amount of iron that is absorbed well. Dried beans and peas, green leafy vegetables and some dried fruit are also sources of iron. However, iron from plant foods is not absorbed as well as iron from animal foods. Consuming foods with vitamin C, such as citrus, tomatoes, or red peppers with meals can help increase iron absorption. Whole-grain, enriched, and iron-fortified bread and cereal products are also good sources of iron (see Table 2).

Iron Absorption

Iron absorption is affected by the iron status of the individual, the type of food eaten, vitamin C intake and other factors in the diet. People with a low reserve of iron will absorb more iron than those with sufficient stores. This is the body's way of trying to maintain adequate levels of iron while protecting against iron toxicity.

Types of Iron: Heme and Non-Heme

There are two forms of iron - heme and non-heme. The iron in meat is about 40 percent heme and 60 percent non-heme. Much of the iron in the diet, however, is in the non-heme form. This is the form found in plant sources such as fruits, vegetables, grain products, and in iron fortified foods. About 25 – 35 percent of heme iron is absorbed, yet this percentage drops to

3 – 20 percent for non-heme iron. This difference is important because heme iron is found only in animal flesh. For this reason vegetarians, compared to non-vegetarians, require 1.8 times the amount of iron when consuming foods that contain only non-heme iron.

Nutrients Affecting Absorption

There are, however, a number of ways to improve iron absorption.

- Foods rich in vitamin C can enhance the absorption of iron. Good sources of vitamin C include citrus fruits and juices, tomatoes, strawberries, melons, dark green leafy vegetables and potatoes. To have an effect, these foods must be eaten at the same meal as the iron source.
- Pairing non-heme (plant) sources of iron with heme (meat) sources of iron during meals also improves absorption. Not only will more total iron be eaten, but the percentage of non-heme iron that is absorbed will be greater.

Other factors may decrease the availability of iron.

- The tannins in both tea and coffee adversely affect iron availability. Coffee and tea consumption at the time of a meal can significantly decrease iron absorption. Tea can cause iron absorption to drop by 60 percent and coffee can cause a 50 percent decrease in iron uptake.
- Phytates in some legumes and grains, phosphates in cola drinks, some proteins in soybeans, and calcium and fiber may also interfere with iron absorption. These may be important factors if the diet is already low in iron.

Vitamin A helps release iron from iron stores in the body and makes it more available for the body to use. Vitamin A deficiencies, therefore, may manifest as iron deficiencies. The use of vitamin A and iron supplementation may help relieve iron deficiency more than iron alone. If there is concern for iron deficiency, it is important to talk with a doctor before beginning iron supplementation.

Iron Toxicity

Because intestinal absorption of iron is regulated by iron stores, iron toxicity is rare. However, there are some conditions in which excess iron is absorbed by the body.

- Consuming large quantities of alcohol may increase the absorption of iron.
- Hemochromatosis, a genetic disorder, causes the body to absorb too much iron from food that is consumed. Once iron is absorbed, it is only excreted through blood loss. Excess iron will build up in tissues and organs. If too much iron accumulates in the body, this may increase the risk for developing certain types of cancer and may eventually lead to death.
- An overdose of iron supplements can cause toxicity in adults and children. However, in children as little as 20 to 60 mg of iron/kg body weight can cause toxicity and death. It is important to keep iron supplements away from children and tightly closed. The tolerable upper limits for iron as set by the Institute for Medicine and the National Academy of Sciences is 40 mg/day for children under the age of 14 and 45 mg/day for anyone 14 years of age or older. This limit is set as the largest amount of iron a person can consume without risk of negative side effects.

Iron and Disease

Heart Disease

Heart disease risk seems to be greater in societies that eat high amounts of red meat versus those that eat minimal amounts. The amount of iron stored in the body can influence a person's potential to develop heart disease. Excess iron is associated with the formation of free radicals, unstable molecules in the body, which may injure vessels supplying blood to the heart. It has also been suggested that the incidence of heart disease rises dramatically in women once menstruation stops due to increased amounts of iron in the blood. However, there is no conclusive evidence that excess iron increases coronary heart disease, so it is not recommended to

eliminate red meat or other iron rich foods from the diet.

Diabetes

Excessive iron stores may play a role in type 2 diabetes. Patients with hemochromatosis have an increased risk for type 2 diabetes and some studies have shown elevated iron levels in patients with type 2 diabetes. Yet, there is not enough scientific evidence to prove a link between iron and type 2 diabetes, and reducing iron intake to treat or decrease the risk of developing diabetes is not recommended.

Restless Leg Syndrome

Restless leg syndrome (RLS) is a neurological movement disorder. People with RLS experience an uncomfortable sensation in their arms and legs that result in the need to move and effects sleep patterns. Iron supplementation relieves the need to move in some patients with RLS. The mechanisms behind iron's benefit to RLS sufferers are not well understood, but they may be linked to iron insufficiencies in spinal fluid or parts of the brain.

Iron-Rich Foods

Consuming a variety of iron-rich foods can help prevent iron deficiency. Refer to MyPlate.gov as a guide for daily food choices. Foods that are a good source of iron are listed below in Table 2.

Table 2: Iron-rich foods.

	Serving size	mg iron
Meats		
liver	3 oz.	7.5
beef	3 oz.	2.6
pork	3 oz.	2.7
lamb	3 oz.	1.6
turkey - dark	3 oz.	2.0
light	3 oz.	1.0
chicken - dark	3 oz.	1.4
light	3 oz.	1.0
fish	3 oz.	0.9
Breads and cereals		
wheat bread, enriched	1 slice	0.6
wheat bread	1 slice	0.5
whole grain cereals	1/2 cup	4.5-9.5
iron fortified cereals	1 cup	1.1-4.5
iron fortified cereals (100% DRI)	1 cup	17.8
macaroni, noodles, enriched	1/2 cup	0.7
Fruits and vegetables		
dried beans, cooked	1/2 cup	2.6
dried peas, cooked	1/2 cup	1.7
lentils, cooked	1/2 cup	2.1
greens, cooked	1/2 cup	1.8
dried apricots	10 halves	1.9
dates	5	1.2
raisins	1/4 cup	1.4
prunes	5 medium	1.2
Dairy products		
none		

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