Nutrition Fact Sheet

An information update for WIC staff

IRON DEFICIENCY

Iron deficiency is the most common type of anemia, especially in children and women of childbearing age. The main cause of iron-deficiency anemia is inadequate intake of dietary iron. Other causes include blood loss associated with gastrointestinal bleeding, surgery, malabsorption of iron related to bowel disease, and dilution of body iron due to increased demands of growth during infancy, childhood, and pregnancy. Iron-deficiency anemia occurs most frequently in:

- *pregnant women, infants, and children due to increased growth needs*
- *women of childbearing age who lose iron through menstruation*
- *economically disadvantaged populations with limited access to food*
- *preterm infants with low iron stores*

SCREENING FOR IRON DEFICIENCY

WIC applicants are screened for iron-deficiency anemia with either of two methods: hematocrit (Hct) or hemoglobin (Hgb). Neither method measures iron status directly, nor does either distinguish among the different types of anemia. Hematocrit measures the volume of red blood cells in 100 milliliters of blood and is reported as a percentage. Hemoglobin, the main component in red blood cells, carries oxygen to the body tissues and carbon dioxide to the lungs. It is reported as grams per deciliter. It is not until stage 2, iron-deficient erythropoiesis, when these measurement values may appear borderline and indicate potential iron deficiency.

Stages and symptoms of iron deficiency

- **Stage 1 (iron depletion)** occurs when the body's iron stores begin to decrease. No symptoms are present and hematocrit and hemoglobin are normal.
- **Stage 2 (iron-deficient erythropoiesis).** Erythropoiesis is the process by which red blood cells are produced by bone marrow cells. **Iron-deficient erythropoiesis** is the beginning of iron deficiency. It occurs when there is limited production of red blood cells, because there is no stored iron, and insufficient transport iron, in the body. Hemoglobin and hematocrit may be marginal. Symptoms may be mild or absent.
- **Stage 3 (iron-deficiency anemia)** occurs when smaller-than-normal red blood cells with less hemoglobin are produced. Hemoglobin and hematocrit are low. Symptoms may include weakness and fatigue, pale skin, and increased infections.

Symptoms depend on how quickly anemia develops. With chronic, slow blood loss, individuals can often adapt and tolerate extremely low concentrations of hemoglobin. Fatigue and irritability in infants and children may also go unnoticed by parents or caregivers.

THE IMPORTANCE OF IRON

Iron is part of the hemoglobin molecule in red blood cells. Hemoglobin carries oxygen from the lungs to all the cells in the body. It also plays an important role in central-nervous-system development, energy production, and immune function.

ABSORPTION

The body's need for iron ultimately determines how much of it is absorbed by the intestine, but absorption also depends on the form of iron and the presence or absence of absorption enhancers or inhibitors.

Iron in foods comes in two basic forms: heme iron and non-heme iron. Heme iron, found in meat, poultry and fish, is well absorbed regardless of what else is eaten with it. Non-heme iron, found in both plants and meats, is poorly absorbed. Heme iron (meats) and vitamin C foods increase the absorption of non-heme iron, while tea, coffee, phytates (a component of plant or grain fibers that bind iron), calcium, and fiber decrease absorption. Therefore, a person will absorb less iron from a meal containing beans and tortillas compared with a meal that also includes ground beef (high in heme iron) or cantaloupe (high in vitamin C). While eggs are often considered a good source of iron, the iron in eggs is poorly absorbed.

WOMEN OF CHILDBEARING AGE AND PREGNANCY

Women of childbearing age, and especially pregnant women, require additional iron to compensate for menstrual loss, tissue growth during pregnancy, and blood loss at delivery and postpartum. Iron deficiency during pregnancy, especially during the first and second trimesters, is associated with an increased risk for preterm delivery and for delivering a low-birthweight baby.

During pregnancy, there is an increased demand for iron (310 to 850 mg) related to the expansion of blood volume and growth of the fetus, the placenta, and other maternal tissues. During the second trimester, a modest drop in hemoglobin concentration occurs naturally due to increased plasma volume. But the concentration rises again in the third trimester. The decrease during the second trimester does not indicate iron deficiency, so the laboratory indicators of iron deficiency are adjusted during the second and third trimesters to reflect these changes.

Prevention of iron deficiency during pregnancy

The Centers for Disease Control and Prevention advocates iron supplementation for all pregnant women. Iron supplements are **not** a substitute for a good diet, but it is generally recommended that all pregnant women take 30 mg of supplemental elemental iron daily between meals, but not with coffee or tea.

INFANCY AND CHILDHOOD

Full-term infants are born with enough stored iron to meet their iron requirements until ages 4 to 6 months, and iron-deficiency anemia does not usually occur until approximately 9 months of age. Infants between the ages of 9 to 18 months are at the highest risk for iron deficiency of any age group. Iron deficiency is typically seen between 1 and 3 years of age, when breastfeeding or iron-fortified formula and infant cereal are replaced by whole cow's milk and table foods.

Preterm and low-birthweight infants are at greater risk of iron deficiency than full-term infants of normal or high birthweight. They are born with lower iron stores and grow faster during infancy. As a result, their iron stores are often depleted by 2 to 3 months of age.

Early introduction or excessive consumption of whole cow's milk are major causes of iron deficiency during infancy and early childhood. Cow's milk has little iron; it may replace foods with higher iron content. Cow's milk may also cause gastrointestinal bleeding due to a sensitivity to proteins in cow's milk during infancy and early childhood.

Iron deficiency during infancy and childhood can have profound, irreversible effects on the central nervous system, including decreased learning ability and motor functioning, and

behavioral problems. Other risks associated with iron deficiency are weakened immune function and the development of lead poisoning due to increased absorption of heavy metals, including lead, by the gastrointestinal tract.

Prevention of iron deficiency during infancy and early childhood

- Encourage exclusive breastfeeding of infants (without supplementary liquid, formula, or food) for 4 to 6 months after birth.
- Offer only iron-fortified formula as a substitute for breastmilk, if a substitute is needed.
- Introduce iron-fortified infant cereal to infants at 4 to 6 months of age (or when the baby is developmentally ready) and iron-fortified adult cereals to preschoolers.
- Encourage foods rich in vitamin C such as fruits, vegetables and juice to improve iron absorption, preferably with meals, starting at 6 months of age.
- Introduce plain, pureed meats after 6 months of age (or when the baby is developmentally ready).
- Avoid whole cow's milk until after the first year, and wean from the bottle between the ages of 12 to 14 months.
- Limit whole cow's milk to no more than 16 ounces a day between the ages of 1 and 2 years.

Suggested readings

Beard, J. L. 2000. "Effectiveness and Strategies of Iron Supplementation During Pregnancy." *Am. J. Clin. Nutr.* 71 (suppl): 1288S–94S.

Buchanan, G. R. 1999. "The Tragedy of Iron Deficiency During Infancy and Early Childhood." *J. Pediatrics* 135: 413–15.

Centers for Disease Control and Prevention. 1998. "CDC Report: Recommendations to Prevent and Control Iron Deficiency in the United States." *MMWR* 47: 1–29.

Wardlaw, Gordon M. 1999. *Perspectives in Nutrition.* Fourth ed. New York: McGraw-Hill. 506–15.

SELF-STUDY QUESTIONS

1. At what stage of iron deficiency do Hgb/Hct values indicate potential iron deficiency?

a) Stage 1

b) Stage 2

c) Stage 3

d) All of the above

2. What role does iron play in growth and development?

a) Development of the immune and central nervous system, and energy production

b) Development of healthy skin

c) Muscle development

d) Bone development

3. The reasons for increased demands for iron during pregnancy include:

a) Menstrual blood loss

b) Increased tissue growth

c) Decreased blood volume

d) Malabsorption

4. The major cause of iron deficiency during infancy and early childhood is:

a) Lead poisoning

b) Fruit-juice consumption

c) Prolonged use of nursing bottles

d) Early introduction or excessive consumption of cow's milk

5. Ways to prevent iron deficiency during infancy include:

a) Encourage exclusive breastfeeding for the first 4 to 6 months.

b) Introduce iron-fortified cereals to infants at 4 to 6 months of age.

c) Offer only iron-fortified formula as a substitute for breastmilk, if a substitute is needed.

d) All of the above.