Iron Deficiency Anemia

Background

Definition Iron deficiency is the most common form of nutritional deficiency. The size and number of red blood cells are reduced. There is a spectrum of iron deficiency ranging from iron depletion, which causes no physiological impairments, to iron-deficiency anemia, which affects the functioning of several organ systems. The terms anemia, iron deficiency, and iron-deficiency anemia are often used interchangeably, but are not equivalent. Anemia can only be diagnosed as iron-deficiency anemia when there is additional evidence of iron deficiency.

Testing A number of tests can be "used to detect iron status, no single test is accepted for diagnosing iron deficiency…Although measures of hemoglobin concentration and hematocrit cannot be used to determine the cause of anemia, a diagnosis of iron-deficiency anemia can be made if hemoglobin concentration or hematocrit increases after a course of therapeutic iron supplementation. Alternatively, other laboratory tests (e.g. mean cell volume, red blood cell distribution, width, and serum ferritin concentration) can be used to differentiate iron-deficiency anemia from anemia due to other causes." See Table 4 (1). Individualization of specific test results are indicated for nonpregnant and pregnant women, by age, weeks' gestation, smoking status, and altitude.

Women should be screened for anemias at their first prenatal care visit, using the anemia criteria for the specific stage of pregnancy. If the screen is positive for anemia, the diagnosis should be confirmed by repeat hemoglobin concentration or hematocrit test. If the pregnant woman is not ill, a presumptive diagnosis of iron-deficiency anemia can be made and treatment and nutrition education can begin. See table 6 (1).

Further evaluation is warranted if the hemoglobin is <9.0 g/dL or the hematocrit is <27.0%, or if the patient has other medical conditions such as sickle cell trait, HIV/AIDS, hepatitis C or thalassmia minor. Anemia from other nutritional deficiencies such as folate or vitamin B12 may also require evaluation. If the hemoglobin concentration is >15.0 g/dL or the hematocrit is >45.0%, during the second or third trimester, there could be potential pregnancy complications related to poor blood volume expansion.

Risk Factors for Iron Deficiency and Iron Deficiency Anemia

Iron deficiency can occur at any time during the perinatal period, due to one or more contributing factors. All risk factors should be assessed and the cumulative effect evaluated. Table 1 provides a summary of some risk factors contributing to iron deficiency and iron deficiency anemia.

Table 1
Risk Factors for Iron Deficiency

Risk Factors	Examples

Diet low in bioavailable iron (See Iron handout)
• Low intake of:
  • Iron rich foods
  • Iron enhancers, – "helpers"
• High intake of:
  • Iron inhibitors - "blockers"
• Presence of iron competitors
	• Food choice and availability limited (See Iron handout)
	  • Diet restriction – prescribed or self-imposed, i.e. vegan
	  • Eating disorder
	  • Food insecurity
	• Lead exposure

Rapid growth	• Adolescence
	• Pregnancy
	  • Increased blood volume
	  • Fetal and placental growth
	  • Other maternal tissues
	• Multiple pregnancy

Blood loss	• Menstruation
	• Gastrointestinal tract
	  ▪ Food sensitivity
	  ▪ Hookworms
	• Contraception – Some intrauterine devices
	• Respiratory tract
	• Surgical procedure
	• Blood donation

Other factors which increase risk of iron deficiency	• High parity
	• Racial group
	  • African American,
	  • Mexican American
	• History of iron deficiency anemia
	• Pica *
	• Impaired absorption
	  • Intestinal malabsorption
	  • Bariatric Surgery
	  • Hypochlorhydria
	• Low socioeconomic status
	• Recent immigrant
	• Infection
	• Hereditary medical disorders causing anemia
	• Extreme exercise

Postpartum risk factors	• Anemia through the third trimester • Excessive blood loss during delivery • Multiple birth

*Women consuming non-food substances, containing or possibly containing lead require further evaluation prior to commencing iron supplementation.

Nutrition Assessment of Iron Deficiency

Perinatal nutrition assessment should include an iron deficiency and iron deficiency anemia assessment Refer to the iron handout for additional biochemical, clinical and dietary assessment information and recommendations.

Table 2
Iron Deficiency Nutrition Assessment

Biochemical data: • Hemoglobin or hematocrit • Mean cell volume, red blood cell distribution, width • Serum ferritin concentration

Clinical factors:
• Age
• Reproductive status
• Prescribed medication and/or over the counter supplements
  • Multiple / Prenatal vitamins and minerals
  • Iron
  • Calcium
  • Antacids
• Risk factors for iron deficiency – see Table 1

Dietary practices and patterns: • Increase and optimize intake of iron-rich foods and foods that enhance iron absorption (See iron handout for further guidelines)

Table 3
Biochemical Indicators
Commonly Used in the Evaluation of Iron Status in Non-pregnant Adults

Stages of Iron Deficiency	Indicator	*Diagnostic Range **
Stage 1 Depletion of iron stores	Stainable bone marrow iron Total iron binding capacity Serum ferritin concentration	Absent > 400 µg/dL < 12 µg/L <20 µg/L + low Hb or Hct indicates iron deficiency (2)
Stage 2 Early functional iron deficiency	Transferrin saturation Free erythrocyte protoporphyrin Serum transferrin receptor	< 16% > 70 µg/dL erythrocyte > 8.5 mg/L
Stage 3 Iron deficiency anemia	Hemoglobin concentration Mean cell volume	< 12 g/dL < 80 fL

Adapted from **Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc** (2002), Iron, p. 302
Food and Nutrition Board (FNB), Institute of Medicine (IOM)
Viteri p. 46
*Laboratory cutoff value is instrument specific and may not apply in all laboratories.
** Collection techniques can impact results.

Table 4
Center for Disease Control (CDC)
Criteria for Anemia in Pregnancy *

Reproductive Stage	Hemoglobin (< g/dL)	Hematocrit (<%)
Non-pregnant and Lactating Women		
• 12-14 years	11.8	35.7
• 15-17 years	12.0	35.9
• ≥18 years	12.0	35.7
Pregnant Women		
• 1st Trimester	11.0	33.0
• 2nd Trimester	10.5	32.0
• 3rd Trimester	11.0	33.0

*At sea-level, non-smoking

There are additional factors that need to be adjusted when assessing the maximum hemoglobin concentration and hematocrit values used in diagnosing iron deficiency anemia.

Table 5
Adjustment of Maximum Hemoglobin and Hematocrit Values for Anemia

<table>
<tr><th>Factors</th><th>Comment</th><th>Adjustment</th></tr>
<tr><td>Smoking status</td><td></td><td>
<table>
<tr><th>Cigarette Smoking Packs per day</th><th>Hgb <g/dL</th><th>Hct %</th></tr>
<tr><td>0.5-<1.0
1.0-<2.0
>=2.0</td><td>+0.3
+0.5
+0.7</td><td>+1.0
+1.5
+2.0</td></tr>
</table>
Adapted from CDC website
</td></tr>
<tr><td>Altitude</td><td>Long-term residency at high altitude (greater than or equal to 3,000 feet) …causes a generalized upward shift in Hb concentration and Hct. The cutoff values should be adjusted for this factor.</td><td>
<table>
<tr><th>Altitude (feet)</th><th>Hgb <g/dL</th><th>Hct %</th></tr>
<tr><td>3,000-3,999
4,000-4,999
5,000-5,999
6,000-6,999
7,000-7,999
8,000-8,999
9,000-9,999
10,000-11,000</td><td>+0.2
+0.3
+0.5
+0.7
+1.0
+1.3
+1.6
+2.0</td><td>+0.5
+1.0
+1.5
+2.0
+3.0
+4.0
+5.0
+6.0</td></tr>
</table>
Adapted from CDC website
</td></tr>
</table>

There are other factors that may influence hemoglobin and hematocrit results including dehydration, collection techniques and glucose metabolism.

Nutrition Education

Everyone requires iron for growth and development, health maintenance and the prevention of chronic disease. It is especially important for women of childbearing age to ensure adequate iron intake and avoid iron deficiency and iron deficiency anemia. See table 6 and the iron handout.

Table 6
Nutrition Education for Iron Deficiency Prevention and Management

	Comment	Guideline

Prevention of iron deficiency anemia in pregnant woman	The Center for Disease Control, American Academy of Pediatrics and American College of Obstetrics and Gynecology recommend universal iron supplementation to meet the iron requirements of pregnancy. This should begin at the first prenatal visit.	• Prenatal vitamin and minerals
		• 30 mg of ferrous iron daily
		• To enhance iron absorption, take iron supplements and prenatal vitamins and minerals
		  • At different times of day
		  • With water or juice
		• Do not take supplements with milk, calcium fortified beverages, coffee or tea

Iron deficiency anemia diagnosed by laboratory criteria	If anemia does not respond to iron supplementation, rule out other conditions, such as folate, vitamin B12 deficiency and non-nutritional causes of anemia such as thallasemia minor or sickle cell trait	• 60-120 mg of ferrous iron daily at any stage of pregnancy
		• Divide into two doses of 60 mg
		• Include
		  o If >30 mg supplemental iron/day, zinc supplementation is recommended (3)
		  o If zinc is administered, 2 mg copper supplement should be given (3)
		• Recheck in 4 weeks
		  o If there is not an increase in hemoglobin by 1 g/dL or in hematocrit by 3%; following the iron supplementation regimen and there is no illness, further evaluate anemia with other tests
		  o In women of African, Mediterranean or Southeast Asian ancestry, mild anemia unresponsive to iron therapy may be due to thalassemia minor or sickle cell trait
		  o When hemoglobin concentration or hematocrit becomes normal for the stage of gestation, decrease the dose or iron to 30 mg/day

		• If needed, evaluate for other nutritional anemias such a s folate or vitamin B12
Iron Deficiency Anemia in the Postpartum women	Postpartum women at risk for anemia should be screened at 4-6 weeks using anemia criteria for nonpregnant women	• If no risk factors are present, iron supplements should be stopped at delivery • Treatment and follow-up is the same as for the non-pregnant women
Barriers to following iron supplementation recommendations	Real or perceived gastrointestinal symptoms, i.e. nausea, vomiting, constipation or diarrhea, from iron supplementation, in addition to morning sickness, are often barriers to following dosage recommendations.	• Determine apparent cause and severity of physical symptoms • Make appropriate suggestions to minimize discomfort • See handout on iron
Elevated hemoglobin	Elevated hemoglobin should be evaluated	• If hemoglobin concentration is greater than 15.0 g/dL or hematocrit is greater than 45.0%, evaluate for o Potential pregnancy complications related to poor blood volume expansion. (1) o Iron overload or Hemochromatosis
There is a high prevalence of iron deficiency and anemia with HIV/AIDS or Hepatitis C	Supplement with caution	Iron supplementation and overload have been associated with increased progression of HIV infection, worsening of hepatitis C virus infection and higher mortality
Warning on iron supplements	*Iron supplements are a common cause of childhood poisonings*	*Warning: Accidental overdose of iron-containing products is a leading cause of fatal poisoning in children under six. Keep this product out of reach of children. In case of accidental overdose, call a doctor or poison control center immediately.*

Referral

When there is an identified need for consultation, assessment, intervention, therapy or resources, refer to the appropriate health care professionals, who have expertise in nutrition and health. Multidisciplinary interventions contribute to improved short term and long term health outcomes

- Refer to registered dietitian for individualized medical nutrition therapy
- Refer the patient to a physician familiar with anemia during pregnancy for further medical evaluation
  - If the hemoglobin is >15.0 g/dL or the hematocrit is >45.0% (2^{nd} & 3^{rd} trimester)
  - If the hemoglobin is <9.0 g/dL or the hematocrit is <27.0%,
  - If the patient has sickle cell trait, HIV/AIDS, hepatitis C or thalassmia minor

Resources

Useful web sites

- Center for Disease Control www.cdc.gov
  - Iron Deficiency in the United States http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5140a1.htm#top
  - Recommendations to Prevent and Control Iron Deficiency Anemia http://www.cdc.gov/mmwr/preview/mmwrhtml/00051880.htm
- USDA Nutrient Data base www.nal.usda.gov/fnic/cgi-bin/nut_search.pl

References

1. U.S Department of Health and Human Services, Centers for Disease Control. Recommendations to prevent and control iron deficiency in the United States. MMWR 1998; 47(RR-3):1-36.

2. Institute of Medicine, Food and Nutrition Board. Iron. In: Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium and zinc. Washington DC: National Academy Press; 2001. p. 290-393.

3. Institute of Medicine, Food and Nutrition Board. Nutrition during pregnancy. Washington D.C.; 1990. p. 305-307

4. U.S Department of Health and Human Services. Healthy People 2010. 2nd ed. With Understanding and Improving Health and Objectives for Improving Health. 2 vols. Washington, DC: U.S. Government Printing Office, November 2000.

5. U.S Department of Health and Human Services, Centers for Disease Control. Current trends CDC criteria for anemia in children and childbearing-aged women. MMWR 1989; 38(22): 400-404.

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01/04