

Iron

Applicable to: Nurses, Physicians, and Other Health Professionals

This nutrition guideline is focused on individuals age 1 and up. For information for infants, please refer to the *Nutrition Guidelines for Healthy Infants and Young Children: Iron*.

Recommendations

The dietary reference intakes for iron change throughout the lifecycle.

Recommended Dietary Allowances (RDA) of Iron (mg/day)				
Age Group	Males	Females	Pregnant Females	Lactating Females
1 to 3 years	7	7		
4 to 8 years	10	10		
9 to 13 years ^a	8	8	27	10
14 to 18 years ^a	11	15 ^b	27	10
19 to 50 years	8	18	27	9
>51 years	8	8 ^c		

^a During growth spurts adolescent boys and girls need extra iron: 2.9 mg/day and 1.1 mg/day above the DRI respectively.

^b Assuming menstruation begins at the age of 14. If it has not begun, the RDA is 10.5mg/day.

^c It is assumed that women 51 years and older are post-menopausal.

- Individuals who are at risk for iron deficiency may have higher iron requirements than the RDA's. For example, people eating vegetarian diets need about 1.8 times more iron than non- vegetarians because the iron from plant foods is not as well absorbed as the iron in animal foods.
- Individuals should take iron supplements, especially single nutrient (iron only) supplements, only if recommended by a physician.
- Iron supplements can be toxic to children. Vitamin and/or mineral supplements that contain iron should be kept out of their reach.



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Health Benefits of Iron

Iron deficiency is the most common nutritional deficiency in the world, thus, it is important to ensure children and adults have an adequate iron intake.¹

Adequate iron intake is important for:

- Normal cognitive and psychomotor development in children.¹
- The delivery of oxygen to the body's tissues and systems. Without enough iron, individuals will tire easily and be less able to fight off infections.¹
- Pregnancy, as it reduces the risk of premature delivery, low birth weight infants, and decreased perinatal mortality.¹

Key Questions**Where is iron found in the body?**

Iron is found in the body as part of several proteins including enzymes, cytochromes, myoglobin, and hemoglobin. About 60% of the body's iron is in hemoglobin (a protein in red blood cells). Hemoglobin carries oxygen throughout the body.¹ About 25% of the body's iron is stored where it can be easily accessed if iron is needed.¹ The remaining 15% of the body's iron is found in myoglobin.¹ Myoglobin carries oxygen to muscle tissues.²

What are the causes and symptoms of iron deficiency anemia?

The main factors that can cause iron deficiency anemia include inadequate intake, poor absorption, increased losses and/or increased physiological demands for iron.³ In this condition red blood cells have an abnormal appearance and are unusually small and pale. This pale colour reflects their low hemoglobin content.

The symptoms of iron deficiency anemia include dizziness, malaise, pallor, and breathlessness as insufficient amounts of oxygen are getting to the body's cells.

It's important to differentiate between iron deficiency anemia (IDA) and anemia of chronic disease (ACD). With ACD, stored iron becomes unavailable, and it is not due to iron deficiency, so treatment with iron will not resolve it.³ All individuals with iron deficiency anemia should be screened for celiac disease.³

For more information about diagnosing and treating iron deficiency anemia, see Alberta's Toward Optimized Practice (TOP) Iron Deficiency Anemia (IDA) Clinical Practice Guideline (2018):

<http://topalbertadoctors.org/cpgs/19444488>

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Who is at risk for iron deficiency?

Individuals with at least one of the characteristics below are at risk for iron deficiency:

Inadequate intake or poor absorption

- Low dietary intake of iron.
- Impaired iron absorption (e.g. bowel problems such as partial gastrectomy, inflammatory bowel disease, celiac disease).⁴
- Following a vegetarian diet. People eating vegetarian diets need about 1.8 times more iron than non-vegetarians because the iron from plant foods is not as well absorbed as the iron in animal foods.¹
- Decreased stomach acidity, such as people who over-consume antacids like Tums® or Zantac® or have decreased acid production in the stomach (because of partial gastrectomy or achlorhydria).¹
- Ingestion of clay, including people with the eating disorder pica, or those who ingest clay for its presumed health benefits.¹

Increased losses

- Have an intestinal parasite. Intestinal parasites can cause significant blood loss and put an individual at risk for iron deficiency.¹
- Donate blood regularly.¹
- Women with heavy menstrual periods.⁴
- Postmenopausal women on hormone replacement therapy (HRT). In some women, HRT can cause uterine bleeding, which increases their iron losses.¹

Increased physical demand for iron

- Pregnant women.⁵
- Performing regular intense exercise. Individual requirements, particularly for females, may be 30% to 70% higher than for people not exercising at this level.¹
- Young children whose intake of cow's milk is excessive and is displacing iron-rich foods.

For more information, refer to *Nutrition Guidelines: Vegetarian Eating; Children and Adolescents*

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What are the iron recommendations?

The dietary reference intakes for iron change throughout the lifecycle. The recommended dietary allowances (RDA) and tolerable upper intake levels (UL) are in Table 1 below.¹

Table 1. Recommended Dietary Allowances (RDA) and Tolerable Upper Intake Levels (UL) of Iron Across Lifecycles

Life stage group	Recommended Dietary Allowances (mg/day)				Tolerable Upper Intake Levels (mg/day)		
	Males	Females	Pregnant Females	Lactating Females	Males	Females	Pregnant/ Lactating Females
1 to 3 years	7	7			40	40	
4 to 8 years	10	10			40	40	
9 to 13 years ^a	8	8	27	10	40	40	45
14 to 18 years ^a	11	15 ^b	27	10	45	45	45
19 to 50 years	8	18	27	9	45	45	45
>51 years	8	8 ^c			45	45	

^a During growth spurts, adolescent boys and girls need extra iron: 2.9 mg/day and 1.1 mg/day above the DRI respectively.

^b Assuming menstruation begins at the age of 14. If it has not begun, the RDA is 10.5 mg/day.

^c Assuming women 51 years and older are post-menopausal.

Why do pregnant women need more iron?

Additional iron is needed during pregnancy to increase the maternal red blood cell mass and to supply iron to the growing fetus and the placenta. Pregnant women can get the iron they need by eating a healthy diet as recommended by Eating Well with Canada’s Food Guide and taking a multivitamin containing 16 – 20 mg of iron every day.⁵

Confirm with pregnant women the type and amount of iron supplements they are taking and discuss whether they have requirements above those stated here.

When iron deficiency with or without anemia is diagnosed, larger doses of iron supplements may be advised to improve iron status.

For more information, refer to *Nutrition Guideline: Pregnancy*

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What about the iron needs of children?

In children, fast growth is considered the main reason for inadequate iron status, thus, it is important to ensure iron is an essential part of children's diets.⁶ Iron is vital for normal cognitive and psychomotor development in children.⁷

Iron needs can be met following Eating Well with Canada's Food Guide according to the child's age and gender. Growing children and adolescents may need to eat frequently throughout the day to meet their nutrient and energy needs.

Young children

Excessive consumption of cow's milk has been identified as the most common risk factor for severe anemia in young children.^{8,9} Children drinking more than 2 cups (500 mL) of milk daily may fill up on milk, displacing iron-rich foods in their diet. Offering milk in an open cup may help to avoid excess consumption.¹⁰

Adolescent boys and girls

There are increased iron requirements due to growth spurts. Iron requirements also increase for girls once they reach the age of menarche.¹ Refer to '*How can an individual ensure they are getting enough iron in their diet?*' below for foods that are sources of iron.

Children and adolescents following a vegetarian or vegan diet

Consultation with a Registered Dietitian is encouraged to ensure nutrient requirements are met.

For additional information please refer to *Nutrition Guidelines: Vegetarian Eating; Children and Adolescents; Healthy Infants and Young Children: Iron; Healthy Infants and Young Children: Introduction of Complementary Foods for Preterm Infants;*

What are the different types of iron in food?

There are two different types of iron found in food: heme and non-heme iron.¹

Heme iron

Only found in animal products like meat, fish and poultry. Heme iron makes up only 7% to 12% of dietary iron. It is well-absorbed by the body and is not greatly influenced by other dietary factors.

Non-heme iron

Found in animal products and plant-based foods such as legumes, vegetables and fruits, whole-grain bread or pasta, tofu, eggs, and fortified foods. Most dietary iron is non-heme. Non-heme iron is not as well-absorbed by the body as heme iron. The absorption of non-heme iron by the body is greatly influenced by dietary factors (refer to the next key question).

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What dietary factors influence non-heme iron absorption?

The amount of non-heme iron absorbed may be enhanced or inhibited by dietary factors.¹

Iron enhancers increase the amount of non-heme iron absorbed

Iron enhancers include:

- **Ascorbic acid:** From vitamin C-rich foods such as oranges, lemons, grapefruit and their juices, cantaloupe, honeydew, kiwi fruit, berries, juices fortified with vitamin C, broccoli, cabbage, cauliflower, kale, peppers, potatoes, and tomatoes. Ascorbic acid releases non-heme iron that is bound to inhibitors (refer to inhibitors section below). Eat vitamin C-rich foods with foods higher in inhibitors like phytates and tannins.
- **Foods with heme iron:** Such as meat, fish, and poultry.

Iron inhibitors decrease the amount of non-heme iron absorbed.

Iron inhibitors include:

- **Phytates:** Found in foods such as legumes (soybeans, black beans, lentils, split peas) and unrefined grains and rice. The absorption of iron from these foods is very low (about 1%). Iron absorption from high-phytate foods is enhanced when they are eaten with vitamin C-rich foods and when these foods are soaked overnight in water or sprouted.¹¹
- **Polyphenols:** Found in tea, coffee, red wine, and many grain products. If vitamin C is consumed with polyphenols, the inhibitory effect of the polyphenols is reduced.¹²
- **Vegetable protein sources:** Protein from legumes may inhibit iron absorption independent of the effect of phytates.¹³
- **Calcium:** Found in milk products such as fluid milk, cheese, and yogurt and calcium supplements.
 - Studies have shown that consuming calcium from food or supplements with meals will decrease the absorption of non-heme iron from that meal. However, the long-term impact of this on iron status is less clear, so avoiding calcium at meal times may not be warranted, especially for healthy individuals.¹⁴
 - Timing iron supplement intake away from calcium intake may be a consideration to help maximize iron absorption for individuals with iron deficiency or iron deficiency anemia.¹⁴
- **Taking supplements with large doses of some inorganic elements:** Such as zinc, manganese, and copper. These can also interfere with non-heme iron absorption.^{3,12}

For additional information please refer to *Nutrition Guideline: Vegetarian Eating*

How can an individual ensure they are getting enough iron in their diet?

- Choose foods that contain iron, such as the foods listed in Table 2.
- Eat vitamin C-rich vegetables and fruit at each meal, or eat high iron foods with good sources of vitamin C.¹
- Cook foods in cast-iron cookware to increase the amount of iron in foods.^{15,16}
- Drink tea or coffee between meals rather than with meals. Tea and coffee have polyphenols that can reduce iron absorption.^{1,17}

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Table 2. Food Sources of Iron

	Excellent sources of iron At least 3.5 mg per serving	Good sources of iron At least 2.1 mg per serving	Sources of iron At least 0.7 mg per serving
Meat, poultry and fish	<ul style="list-style-type: none"> • Liver, beef, chicken or pork*, 2½ oz (75 g) • Moose, 2½ oz (75 g) • Mussels or oysters, 2½ oz (75 g) • Wild duck or goose, 2½ oz (75 g) 	<ul style="list-style-type: none"> • Beef, 2½ oz (75 g) • Elk, 2½ oz (75 g) • Sardines, 2½ oz (75 g) • Venison, 2 ½ oz (75 g) 	<ul style="list-style-type: none"> • Chicken, 2½ oz (75 g) • Clams, canned, 2½ oz (75 g) • Lamb, 2½ oz (75 g) • Pork, 2½ oz (75 g) • Light canned tuna, 2½ oz (75 g)
Meat alternatives (legumes, nuts, seeds and eggs)	<ul style="list-style-type: none"> • Chickpeas or lentils, cooked, ¾ cup (175 mL) • Pumpkin seed kernels, roasted, ¼ cup (60 mL) • Soybeans, mature, cooked, ¾ cup (175 mL) 	<ul style="list-style-type: none"> • Chia, flax, or sesame seeds, ¼ cup (60 mL) • Red kidney beans, cooked, ¾ cup (175 mL) • Tofu, firm, ¾ cup (175 mL/ 150 g) 	<ul style="list-style-type: none"> • Almond, cashew, peanut or sunflower seed butter, 2 Tbsp (30 mL) • Eggs, 2 • Split peas, ¾ cup (175 mL)
Grains	<ul style="list-style-type: none"> • Cold cereal, enriched, 30 g • Instant hot cereal, enriched, cooked, ¾ cup (175 mL) 	<ul style="list-style-type: none"> • Amaranth, ½ cup (125 mL) • Baby cereal with iron, 2 Tbsp (30 mL) • Wheat germ, ¼ cup (60 mL, 30 g) 	<ul style="list-style-type: none"> • Bagel, ½ (52 g) • Bread, enriched, 1 slice (35 g) • Oatmeal, cooked, ½ cup (125 mL) • Pasta, enriched, cooked, ½ cup (125 mL) • Quinoa, cooked, ½ cup (125 mL)
Vegetables and fruit		<ul style="list-style-type: none"> • Chard, boiled, ½ cup (125 mL) • Lima beans, boiled, ½ cup (125 mL) • Spinach, boiled, ½ cup (125 mL) 	<ul style="list-style-type: none"> • Asparagus, boiled, ½ cup (125 mL) • Beets, canned, ½ cup (125 mL) • Dried apricots, ¼ cup (60 mL) • Dried figs, 5 • Green peas, ½ cup (125 mL) • Potato, baked with skin, ½ medium • Pumpkin, cooked/canned, ½ cup (125 mL) • Raisins, ¼ cup (60 mL)
Other	<ul style="list-style-type: none"> • Molasses, blackstrap, 1 Tbsp (15 mL) 		

Values from Health Canada, Canadian Nutrient File¹⁸

*Liver is high in vitamin A. Pregnant women should limit their intake of liver to 100 g a month. High amounts of vitamin A can harm a developing baby. For more information, refer to *Healthy Parents Healthy Children: A Practical Guide to Pregnancy and Being a Parent*, available at: <http://www.healthyparentshealthychildren.ca/starting-off-healthy/eating-during-pregnancy/food-safety/safer-alternatives/>.

For additional information please refer to *Nutrition Guideline: Vegetarian Eating; Pregnancy*

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Can an individual get too much iron?

Yes, an individual can consume too much iron from food and supplements. The risk of consuming too much iron from food alone is low. The most likely cause is from excess iron supplements.¹

Too much iron can cause:

- Gastrointestinal side effects (constipation, nausea, vomiting, and diarrhea).
- Acute toxicity (vomiting and diarrhea followed by cardiovascular, central nervous system, kidney, liver, and hematological effects).
- Secondary overload (increased iron stores due to parenteral iron administration, frequent blood transfusions, or hematological dysfunction).
- Reduced zinc absorption when supplemental iron is not taken with food.

Children and youth (aged 0–13 years)

Should not consume more than the upper limit of 40 mg per day of iron, unless recommended by their physician. Children and youth should not take iron supplements unless recommended by a physician.

Adults and adolescents (age 14 and older, including pregnant and breastfeeding women)

Should not consume more than the upper limit of 45 mg per day of iron, unless recommended by their physician. Adults and adolescents should not take iron supplements unless recommended by a physician.

Individuals at increased risk of excess iron intake include those with hereditary hemochromatosis; chronic alcoholism, alcoholic cirrhosis and other liver diseases; iron-loading abnormalities (thalassemias); congenital atransferrinemia (absence of transferrin); aceruloplasminemia (genetic disorder). The upper limits for iron intake do not apply to these conditions.¹⁹ If individuals with these conditions consume close to the upper limits, they may get too much iron and experience the adverse effects listed above.

What about iron supplements?

Most individuals can meet iron requirements by following Canada's Food Guide and by regularly eating higher iron foods.

Individuals should take iron supplements, especially single-nutrient (iron only) supplements, **only** if recommended by a physician. Single-nutrient iron supplements may have higher dosages, which should be monitored by a healthcare provider.

If a physician has recommended iron supplements, individuals should talk to the physician, a pharmacist, or another healthcare provider about what type of supplements to take and when to take them.

- Iron supplements are most often available as ferrous and ferric ion salt such as ferrous fumarate, ferrous sulfate, ferrous gluconate, ferric sulfate, and ferric citrate. Since ferrous ions have a higher solubility than ferric ions, ferrous supplements have better absorption than ferric supplements.⁴
- Individuals and healthcare providers should note how much elemental iron (the iron that is available for absorption) is in the supplement. Elemental iron is listed on the supplement label.
- Iron absorption decreases with increasing doses; therefore, daily supplements should be spread over two or three evenly spaced doses.⁴

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For more information about using iron supplements to treat iron deficiency anemia, see Alberta's Toward Optimized Practice (TOP) Iron Deficiency Anemia (IDA) Clinical Practice Guideline (2018):

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When taken without food, iron supplements may decrease zinc absorption.⁴ This does not occur when iron supplements are taken with food. Individuals are encouraged to take iron supplements with food.¹

Iron can be toxic to children if consumed in excess of a healthcare provider's recommended dosage. All vitamin and/or mineral supplements that contain iron should be kept out of children's reach.

Is there any evidence to recommend the Lucky Iron Fish™ to treat iron deficiency?

The Lucky Iron Fish™ is a small block of iron in the shape of a fish. It was created to address iron deficiency in rural Cambodia. It is marketed as a way to add iron to the diet, by boiling the Fish in water and using that water in cooking or to drink.

Studies have shown inconsistent results in increasing hemoglobin levels and improving iron deficiency anemia.²⁰ There is insufficient evidence to recommend the use of the Lucky Iron Fish™. However, the use of the Lucky Iron Fish™ does not appear to pose a risk as contaminants were either undetectable or below acceptable standards set by the World Health Organization.²¹

Are there any handouts on iron I can use with my patients?

Refer to approved provincial Alberta Health Services iron handouts to support patient education. For more information, contact Nutrition.Resources@albertahealthservices.ca

For more information about using iron supplements to treat iron deficiency anemia, see Alberta's Toward Optimized Practice (TOP) Iron Deficiency Anemia (IDA) Clinical Practice Guideline (2018):

<http://topalbertadoctors.org/cpgs/19444488>

Healthy Parents Healthy Children: A Practical Guide to Pregnancy and Being a Parent, available at:

<http://www.healthyparentshealthychildren.ca/starting-off-healthy/eating-during-pregnancy/food-safety/safer-alternatives/>.

Access to referenced Nutrition Guidelines can be found at:

<https://www.albertahealthservices.ca/info/Page3505.aspx>

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