Iron Deficiency - Part Five

All right. Now, let's move into treatment of iron deficiency. As is often the case, diet is always the first consideration, and as I've mentioned, vegetarians and vegans are at higher risk of deficiency. Heme iron, found in animal products, is much better absorbed than nonheme iron, which is found in plant sources of iron. The U.S. Food and Nutrition Board has estimated that the bioavailability of iron from a vegetarian diet is about half what it is from an omnivorous diet, so not only is the amount of iron that vegetarians and vegans consume lower, the bioavailability of that iron is lower.

The absorption of plant-based forms of iron are inhibited by other commonly consumed substances such as coffee, tea, dairy products, supplemental fiber, and supplemental calcium. This explains why vegetarians and vegans have lower iron stores than omnivores and why vegetarian diets have been shown to reduce nonheme iron absorption by 70 percent and total iron absorption by 85 percent. We'll put a link to the studies so you can check these out if you're interested in the resources section.

U.S. RDA for iron

Life Stage	Age	**Males** (mg/day)	**Females** (mg/day)
Infants	0-6 months	0.27 (AI)	0.27 (AI)
Infants	7-12 months	11	11
Children	1-3 years	7	7
Children	4-8 years	10	10
Children	9-13 years	8	8
Adolescents	14-18 years	11	15
Adults	19-50 years	8	18
Adults	51 years and older	8	8
Pregnancy	all ages	-	27
Breast-feeding	18 years and younger	-	10
Breast-feeding	19 years and older	-	9

Adapted from: "Food and Nutrition Board, Institute of Medicine. Iron. Dietary reference intakes for vitamin A, vitamin K, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. Washington D.C.: National Academy Press; 2001:290-393"

Here is the U.S. RDA for iron segregated by population. Note that the RDA is not the amount that is required for optimal health. It's the amount that is required to avoid acute deficiency symptoms. Also note that the RDA does not take into account the differences in the bioavailability of heme and nonheme iron that we just talked about, so in other words, eight mg a day coming from nonheme iron will not be absorbed at an equivalent amount to eight mg of heme iron, nor does

the RDA take into consideration other substances that increase or decrease iron absorption, so it's really a crude measurement. If you're practicing individualized medicine, you need to be thinking about it at a much deeper level and considering all of your individual patients' circumstances.

Furthermore, the RDA doesn't consider certain populations that often need more iron, including women with dysmenorrhea, or regular blood loss; people with inflammatory bowel disease or other gastrointestinal bleeding disorders; people who exercise intensely; and vegetarians and vegans. You really need to think about those factors when you're determining how much iron your patients need.

Heme iron is found almost exclusively in animal products. About 10 percent or less of dietary iron in the U.S. in the average diet is heme iron despite high meat intake. People with normal iron metabolism will absorb only 20 to 25 percent of heme iron contained in food. For example, on paper, a four-ounce hamburger contains three mg of iron, 1.2 mg of heme, and 1.8 mg of nonheme, and about 0.4 mg of heme iron will be absorbed from that four-ounce hamburger. This is why it's important to consider absorption, not just look at the amount of iron that is contained in a food on paper.

Highest sources of heme iron

Food	Amount (mg per 100g)
Clam	28
Chicken liver	13
Oyster	12
Octopus	10
Beef liver	7
Venison	5
Mussel	4
Beef chuck	4
Bison, ground	3
Crab	3
Duck breast	3
Lamp shoulder	3
Pork shoulder	2

As you can see, shellfish such as clams and oysters and organ meats are the highest sources of iron by a significant margin. Clams have 28 mg per 100-gram serving, and then chicken liver is 13, oysters are 12, octopus is 10, and beef liver is seven. Then you have to go all the way down to four before you get to mussel meat. I've often advocated for consumption of organ meats and shellfish as the most nutrient-dense food, and you'll see this not only with iron but with other vitamins and minerals, things such as zinc, for example, and copper. Shellfish are very rich sources. Frankly, you can make the argument that if someone is mostly a vegetarian, but they eat organ meats and shellfish, he might have a higher nutrient intake than someone who is on a Paleo-type diet and eats a lot of muscle meat but doesn't eat any organ meats. When I mention that to my patients, it definitely helps get the point across. If possible, shellfish and organ meats should be a part of the diet, especially when nutrients such as iron are deficient.

Highest sources of non-heme iron

Food	Amount (mg per 100g)
Spices (thyme, parsley)	15-128
Pumpkin seeds	15
Sesame seeds	15
Tomatoes, sun-dried	9
Natto	9
Baked potatoes	7
Sunflower seeds	7
Hazelnuts	5
Soybeans, boiled	5
Spinach, cooked	4
Tomatoes, canned	3
Spinach, raw	3
Beet greens, cooked	2
Swiss chard, raw	2

Here are the plant sources of iron. Spices are by far the highest source, but you're obviously not going to eat 100 g of dried thyme. If you go down to the next highest category, you see that certain seeds such as pumpkin and sesame seeds are rich in plant-based nonheme iron. The humble potato is a good source, as are canned and dried tomatoes. Then we have spinach, beet greens, and chard are the highest plant sources, but they, of course, pale in comparison to shellfish even on paper, and that is without considering the much higher bioavailability of heme iron and the fact that spinach, beet greens, and chard contain oxalates that block iron absorption.

Given that the U.S. RDA for females is 28 mg of iron per day, it's not hard to see how vegetarians and vegans could become deficient, and this is especially true if they are consuming substances that decrease iron absorption such as coffee and tea, which most people are.

Substances that decrease iron absorption

Substance	Comments
Calcium	Inhibits both heme/nonheme
Eggs	Contain phosvitin, which inhibits iron absorption
Oxalates	Spinach, kale, beets, nuts, chocolate, tea, berries, some spices/herbs
Polyphenols	Cocoa, coffee, teas, apples, berries, walnuts, some spices
Phytate	Walnuts, almonds, sesame, dried beans, lentils and peas, and cereals and whole grains
High doses of zinc	Limit to 20 mg per dose, taken between meals
Medications	Proton pump inhibitors (PPIs) and other antacids

In addition to the iron content of foods, it's important to be aware of foods and substances that decrease and increase iron absorption. We'll start with those that decrease iron absorption. Calcium is the only known substance that inhibits both heme and nonheme iron absorption, and 50 mg or less of calcium per dose has little if any effect on iron absorption. Calcium in amounts ranging from 300 to 600 mg has been shown to inhibit the absorption of heme iron similarly to nonheme iron, so that amounts to about one cup of skim milk. That contains about 300 mg of calcium.

If calcium supplements are ever necessary, which is extremely rare in my opinion, and we'll be talking about that in more detail, calcium supplementation has not been shown to be beneficial for osteoporosis in elderly women, and it has been shown to increase the risk of heart disease in both men and women. If calcium supplements are for some reason necessary, they are best taken at bedtime away from food so that they don't inhibit iron absorption.

Interestingly enough, eggs contain a compound called phosvitin that impairs absorption of nonheme iron, and this may be responsible for the poor bioavailability of iron in eggs. One boiled egg can reduce the absorption of iron in a meal by as much as 28 percent. So, if a patient is suffering from iron deficiency, you may want to advise them not to eat eggs with iron-rich foods.

Oxalic acid, or oxalates, impair the absorption of nonheme iron. These are found in foods such as spinach, kale, beets, nuts, chocolate, tea, wheat bran, rhubarb, strawberries, and herbs such as oregano, basil, and parsley. The presence of oxalic acid in spinach explains why the iron in spinach is not well absorbed.

Polyphenols are major inhibitors of iron absorption. These include cholinergic acid found in cocoa, coffee, and some herbs; phenolic acid found in apples, peppermint, and herbal teas; and tannins found in black teas, coffee, cocoa, spices, walnuts, and fruits such as apples, blackberries, raspberries, and blueberries. These all have the ability to inhibit iron absorption. Some teas, in fact, inhibit iron absorption by up to 90 percent, and coffee inhibits it by 60 percent. So, again, if you have a patient with iron deficiency, these should probably not be consumed in meals that have a lot of plant-based iron. Remember too that when we're talking about inhibition of iron absorption here, with the exception of calcium, we're only talking about inhibition of nonheme or plant-based forms of iron.

Phytic acid, or phytate, is a compound contained in soy protein, fiber, nuts, and veggies. Even low levels of phytate, about 5 percent of the amounts in cereal and grains, can reduce iron absorption by 50 to 65 percent, so this is a very significant effect.

Then we have high-dose zinc, which can interfere with copper utilization, leading to impaired iron metabolism. You should limit zinc supplementation to less than 20 mg per dose and take it between meals.

Finally, there are medications that decrease iron absorption, particularly those that reduce stomach acid such as proton pump inhibitors and other antacids.

Substances that increase iron absorption

Substance	Comments
Vitamin C	100 mg increases iron absorption in a meal by over 4-fold
Beta-carotene	Apricots, beets, carrots, collards, red grapes, red peppers, spinach, tomatoes, etc.
Hydrochloric acid	HCL supplements
Meat (especially red meat)	100g of red meat increases non-heme absorption by fourfold
Sugar	Fruit, honey, black-strap molasses
Alcohol	In moderation with meals; excess alcohol in conjunction with excess iron damages liver

Okay, let's talk a little about substances that increase iron absorption. We have vitamin C, and 100 mg of ascorbic acid increased iron absorption from a specific meal by 4.14 times in one study. Beta-carotene significantly increases iron absorption. It can even cancel out the inhibitory effects of tannins and phytates, if the concentration isn't too high. If you have coffee, drink some carrot juice with it. It's best to get these beta-carotenes from food, since beta-carotene supplementation has shown harm over the long term in several studies. Also note that retinol, the active form of vitamin A, does not increase iron absorption. Note that many foods that are high in beta-carotene also are high in oxalate and phytate, which decrease iron absorption, so it makes beta-carotene a less practical strategy for actually increasing iron absorption, and we don't use it in our clinic as a recommendation.

Hydrochloric acid, or HCl, is present in the stomach, and it frees nutrients from food so that they can be absorbed, including iron, so HCl supplements can significantly increase iron absorption.

Red meat is not only a great source of iron itself, it increases the absorption of nonheme iron. So, for example, one g of meat has an enhancing effect on nonheme iron absorption equivalent to that of one mg of ascorbic acid. Put a different way, 100 g of meat will increase iron absorption by up to four times.

Sugar increases iron absorption, but refined sugar is obviously not recommended for this purpose. There are other, better ways to do it, but fruits or adding honey or blackstrap molasses to foods, for example, can boost iron absorption and add nutrients that are lacking in refined sugar. So, if you have to use sweeteners, use those.

Finally, alcohol also increases iron absorption, so an occasional glass of wine with meals, especially meals containing shellfish and organ meats, might be a good way of increasing iron status. If your patient is subject to abusing alcohol, obviously you don't want to recommend that as a strategy because excess alcohol in conjunction with excess iron can really damage the liver.