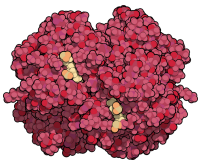
IRON DEFICIENCY AND FEMALE ATHLETES

SPRING FORWARD FOR GIRLS

There is a lot of talk about iron and ferritin levels, and how in athletes, specifically endurance athletes, these levels should be monitored. Let's explore it all in more depth.

Iron Deficiency
Low iron levels despite normal hemoglobin levels.

Iron Deficiency Anemia
Low iron levels AND low hemoglobin levels - true anemia.



Iron
The component of blood that directly binds to oxygen. Iron is found in the heme subunits that make up hemoglobin.

Hemoglobin
The component of blood that carries oxygen. Each hemoglobin consists of 4 heme subunits which each carry one oxygen molecule via binding to iron.

Both iron deficiency and iron deficiency anemia can lead to impaired athletic performance.

What is Iron Deficiency?

First, it is important to understand why we care about iron. Many athletes know that iron deficiency can cause anemia - but how does that work?

True anemia is when hemoglobin levels are low. Hemoglobin is the oxygen carrying component in blood. When there is lower iron in the blood, there is less oxygen carried and performance parameters, including VO2 max, are affected.

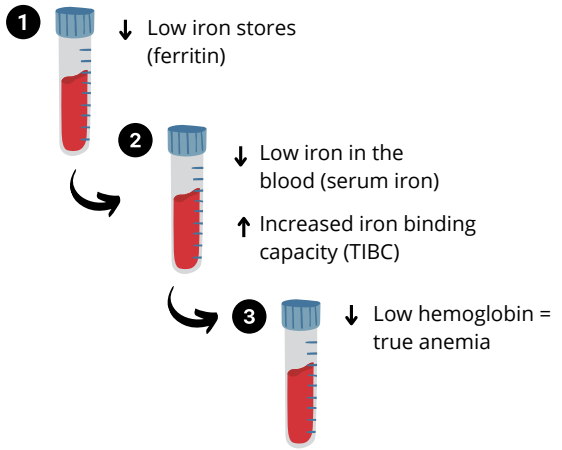
How Does Iron Deficiency Occur?

Iron deficiency happens in stages.

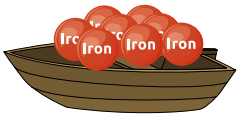
Only the late stage of iron deficiency has anemia (low hemoglobin) present. In the earliest stage, iron stores (ferritin) are low. In the middle stage, there is also low serum (circulating blood) iron levels and potentially elevated TIBC.

TIBC is iron binding capacity and measures the ability of transferrin to bind to iron. Transferrin binds to oxygen to carry it through the bloodstream. So, TIBC will elevate when iron stores are low.

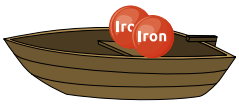
Try to think about transferrin as boats carrying iron. The more empty iron seats on the boats means more capacity - so TIBC it will go up as iron levels go down.



There are three stages of iron deficiency.



high iron = low TIBC
"less seats on the boat for iron" means lower binding capacity



low iron = high TIBC
"more seats on the boat for iron" means higher binding capacity

When iron is low, less iron binds to transferrin. This makes transferrin more prone to bind iron when iron is present. This binding affinity is known as TIBC and is elevated when iron is low.

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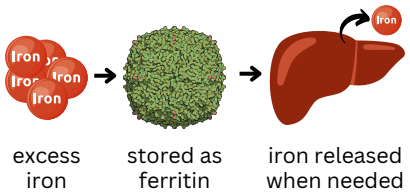
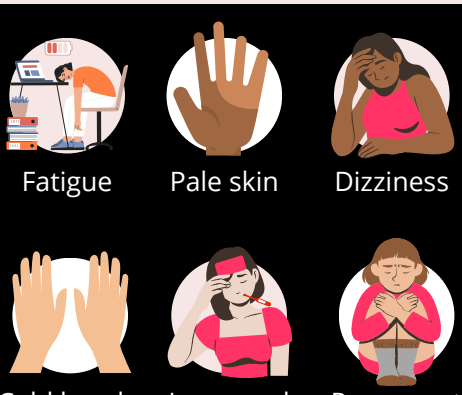
What About Ferritin?

Ferritin is a marker of iron stores and having a low level of ferritin may lead to earlier fatigue even in the absence of anemia. Roughly 25 % of the iron in our body is bound to ferritin. Ferritin can also be artificially high in times of stress or disease or inflammation. Normal ferritin levels vary in different labs, but in general range from around 10-300 ng/mL. Endurance athletes like runners or swimmers use more iron, but exactly how much is not established. There have been studies showing that values of 10-20 ng/mL correlates to iron deficiency anemia. There is also evidence that endurance athletes with ferritin less than 50 and a normal hemoglobin may feel fatigued and have improvement with iron supplementation or increasing iron in their diet.



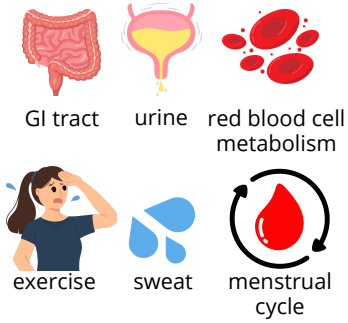
Ferritin is the storage form of iron.

Just because ferritin is low, does not mean serum iron (iron in the blood) is low. Athletes with low ferritin can still experience fatigue and poor performance outcomes.



So... How Can I Know If I Am Iron Deficient?

Symptoms of iron deficiency can vary from athlete to athlete. Often the symptoms occur slowly over time and are vague and hard to differentiate from many other conditions. Symptoms may consist of fatigue, paleness, weakness, decreased endurance, cold intolerance, susceptibility to illness, decreased focus and performance. It is advisable to see a physician familiar with expected lab values for athletes. Simply measuring a hemoglobin without other markers is inadequate for evaluation.



The body can lose iron in a number of ways.

How Do We Lose Iron From Our Body?

People lose iron normally through the GI tract, urine, red blood cell metabolism, sweat and vigorous exercise. Females also lose iron through menses. It is not established how much more athletes may lose through exercise. Each person is different and we have genetic factors, different rates of absorption. A typical sedentary person needs 8 mg day of iron (males and post menopausal females) and 18 mg day (females).

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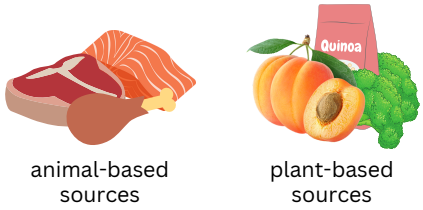
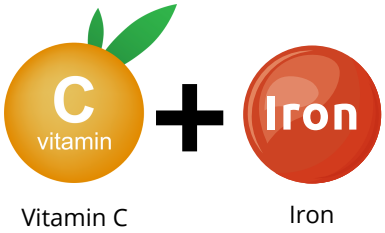
I'm Iron Deficient! What Should I Do?

Iron sources in the diet come from two sources, heme and non-heme iron. Heme sources are animal sources like beef, poultry and fish. Non-heme sources include some vegetables (spinach, broccoli) fruits (apricots and some berries) and nuts. Cereal can be fortified and many cereals have a large helping of non-heme iron. Vitamin C is also needed to absorb iron, while coffee and black tea can inhibit iron absorption.



Dietary iron can come in two forms - heme and non-heme iron.



Taking iron supplementation with a source of vitamin C (e.g. an orange) can increase absorption of iron.

Iron supplements come in many forms. Ferrous sulfate (65 mg elemental iron) and gluconate (36 mg elemental iron) are available in most stores. A heme source of iron is available called Proferrin which may be more easily tolerated. Be sure to take any supplement with vitamin C for better absoprtion. Iron can cause GI upset and diarrhea. There is a possibility of GI bleeding, so individuals with a history of GI problems should consult a physician before taking iron. Liquid iron supplements can be taken by straw to avoid discoloration of teeth.

Not every athlete should take iron. It does not give energy to athletes who are not depleted. Be very careful to have iron studies monitored while supplementing as there is a possibility of iron toxicity with too much intake. During times of rest between seasons, less iron may be needed.

Getting a full evaluation with iron studies interpreted by a physician familiar with the needs of athletes can be helpful.

Written by Kathryn Vidlock MD

The Overall Message...

1. We are all unique individuals and some may feel tired with a low ferritin - even with levels below 50 and some may not feel symptoms until depletion is lower.
2. Having a full evaluation with iron studies interpreted by a physician familiar with the needs of athletes can provide useful information.

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Citations

Reinke S, Taylor WR, Duda GN, et al. Absolute and functional iron deficiency in professional athletes during training and recovery. Int J Cardiol. 2012;156:186–191.

Koehler K, Braun H, Achtzehn S, et al. Iron status in elite young athletes: gender-dependent influences of diet and exercise. Eur J Appl Physiol. 2012;112(2):513–523. doi:10.1007/s00421–011–2002–4