iron deficiency anemia and exercise

Why athletes and other active clients may have increased iron needs—and the best food sources to prevent iron depletion and sports anemia.

Most fitness professionals know that exercise can put stresses on the body that ultimately increase one’s daily nutrient needs. Athletes and other active people know that they need to monitor their carbohydrate, protein and fat intake and stay hydrated to support their demanding workouts. They realize that a lack of carbohydrates can hurt performance and that without protein the body is susceptible to infection, loss of lean body mass and fluid imbalances.

What many fit people often fail to take into account is their daily intake of key vitamins and minerals, which are essential to support the body’s ability to exercise intensely. One essential nutrient that often goes unnoticed until it becomes problematic is the mineral iron.

Iron’s Role in the Active Body

Iron plays a key role in oxygen transport and fuel utilization (Schumacher et al. 2002). Did you know that the mineral is also indispensable for the following bodily functions?

• Iron is essential for the synthesis of hemoglobin and myoglobin, the proteins that transport oxygen to the blood and muscle, respectively (Burke & Deakin 2000).
• It is a crucial component of the electron transport system that controls the energy release from cells (Burke & Deakin 2000).
• It is involved in DNA synthesis and red blood cell production.
• It acts as a catalyst against harmful free-radical production (Burke & Deakin 2000).

But how exactly does this mineral affect peak physical performance? When an athlete operates without adequate iron, less oxygen is delivered to the muscles, maximal oxygen consumption (VO$_2$ max) drops, and physical performance suffers (Rockwell & Hinton 2005). Additionally, too little iron may impair immune and other physiological functions (Beard & Tobin 2000).

The Iron Depletion Process

Although iron depletion is a continuous process, it can be categorized into three stages:

• depletion of iron stores (but with functional iron unchanged)
• early functional-iron deficiency without anemia
• iron deficiency anemia (Burke & Deakin 2000; Rockwell & Hinton 2005)

In the first two stages, hemoglobin stores appear normal and iron depletion can easily go undetected or is often dismissed as being insignificant; nevertheless, low iron stores can be detrimental to athletic performance (Rockwell & Hinton 2005).

The final stage of iron depletion is anemia, which is defined as a low hemoglobin concentration in the blood, regardless of the cause (Beard & Tobin 2000). Clinical symptoms and the overall effect on performance capacity can vary between individuals at each stage of the iron depletion process, but symptoms may eventually include reduced endurance capacity, lethargy, poor concentration, irritability and increased risk of injury (Rockwell & Hinton 2005).

Testing Iron Depletion

Iron status is determined by blood testing. If a client’s initial test indicates low iron status, the client should be considered at potential risk for developing anemia (Burke & Deakin 2000).

First and foremost, any athlete with low iron status should be referred for additional blood tests and further evaluation. As a preventive measure, an array of biochemical measures can be conducted to further evaluate iron status (Burke & Deakin 2000). Routine indicators include serum iron, ferritin, transferrin, transferrin saturation and hemoglobin; a full blood count should also be taken (Burke & Deakin 2000). Repeated measurements, combined with other diagnostic tools (such as clinical and dietary assessment), would give a better assessment of the athlete’s true iron status (Burke & Deakin 2000).

Iron Losses in the Active Body

Elite and recreational athletes who train hard will deplete their iron stores much faster than less physically active people (Rockwell & Hinton 2005). An athlete can lose iron through sweat, urine and the gastrointestinal tract (Rockwell & Hinton 2005). Female athletes are at greater risk of iron depletion and often have difficulty meeting iron requirements through diet (Burke &
While the stress of exercise is a significant factor, dietary choices cause most cases of iron depletion. Vegetarian athletes are especially vulnerable in this regard, because they avoid animal sources of dietary iron, known as heme iron, which is more effectively absorbed than the nonheme iron from plant sources (Rockwell & Hinton 2005). In fact, heme iron provides up to one-third of all absorbed dietary iron (Rockwell & Hinton 2005).

Athletes who regularly restrict their caloric intake in order to lose or maintain a certain weight are also probably getting inadequate iron, unless they are specifically focusing on eating foods that are rich in iron. However, that kind of focus takes considerable effort and planning, which is why so few athletes stick to that approach.

Achieving Adequate Iron

Unfortunately, the body cannot manufacture its own iron and is thus dependent on food intake for an adequate supply (Burke & Deakin 2000). Most nutrition experts question the need and long-term safety of taking daily iron supplements to prevent iron depletion. That’s because there is a plethora of foods that are very good sources of bioavailable, or readily absorbed, iron. For a look at some common examples, see “Good Sources of Iron in Food,” below.

Keep in mind that the way we combine foods in any given meal can also enhance iron absorption (Rockwell & Hinton 2005). Here are some practical food-pairing ways that will optimize the iron in your diet:

- Combine plant nonheme iron sources, such as lentils and green, leafy veggies, with foods that are high in vitamin C, such as orange juice.
- Use cast-iron cookware, which may increase the iron content of cooked foods.
- Don’t drink tea and coffee while eating iron-rich foods, since both beverages can impair iron absorption.
- Avoid pairing iron-rich foods with certain grains, such as wheat bran, or with veggies such as spinach, rhubarb, chard and beet greens. These foods contain chemical compounds called phytates and oxalates, which impair iron absorption.
- Don’t mix calcium-rich beverages, like milk and fortified orange juice, with foods that are high in iron, since calcium can also inhibit iron absorption (Rockwell & Hinton 2005).

What Is Sports Anemia?

Sports anemia is a condition that can cloud the iron deficiency anemia diagnosis in athletic populations (Rockwell & Hinton 2005). Some experts believe that the term sports anemia is misleading and are discouraging its use, because true anemia refers to low hemoglobin concentration, and this is not the case with sports anemia (Burke & Deakin 2000).

In actuality, sports anemia is a beneficial adaptation to endurance training (Eichner 1992). This kind of training increases the volume of blood plasma, which in turn dilutes red blood cells, making hemoglobin and hematocrit measurements appear to be falsely low (Rockwell & Hinton 2005). Furthermore, the increased plasma volume and blood fluidity also facilitate oxygen delivery to the exercising muscles, which is advantageous for heat dissipation, greater cardiac stroke volume and lower heart rate during exercise (El-Sayed et al. 2005). Sports anemia is more a matter of exercise-induced increases in plasma volume, as opposed to genuine iron depletion, in that red blood cell production is by no means inhibited (Burke & Deakin 2000; El-Sayed et al. 2005). Sports anemia can easily go undetected since it is unlikely to hinder athletic performance in the way that true anemia does (Eichner 1992).

It can be quite difficult to differentiate between sports anemia and true iron deficiency/iron depletion from a single blood test using readily available iron status measures (Burke & Deakin 2000). An athlete with sports anemia may have a falsely low iron status profile that looks similar to the profile of someone with iron deficiency anemia (Burke & Deakin 2000). That’s why routine iron screening is essential in order to identify pseudo-anemia in highly trained athletes, while also protecting them against real iron deficiency (Rockwell & Hinton 2005). To minimize the effects of sports anemia, blood tests should preferably be done prior to the start of the sports season or a few weeks into training (Rockwell & Hinton 2005).

Sports anemia often occurs early in an athlete’s training program, especially after a period of rest or recovery from injury or following an endurance phase (Burke & Deakin 2000). More specifically, the hemodilution process takes place during the 48 hours following each training session and can persist for as long as a week (Chatard et al. 1999).

Pumping Iron Into Athletes

The good news is that many college programs are already screening female endurance athletes for iron status; however, such practice should be broadened to include endurance athletes of both genders (Rockwell & Hinton 2005). In the meantime, fitness professionals who work with athletes need to be aware of

<table>
<thead>
<tr>
<th>Animal Sources (heme iron)</th>
<th>Plant Sources (nonheme iron)</th>
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<tbody>
<tr>
<td>liver</td>
<td>iron-enriched breakfast cereal</td>
</tr>
<tr>
<td>roast beef, steak</td>
<td>nuts (cashews, almonds)</td>
</tr>
<tr>
<td>roast lamb</td>
<td>sweet corn, potato</td>
</tr>
<tr>
<td>eggs</td>
<td>lentils, baked beans in sauce, bean soup, chili with beans</td>
</tr>
<tr>
<td>dark-flesh tuna</td>
<td>whole-grain foods (oatmeal, sunflower seeds)</td>
</tr>
<tr>
<td>lean pork, ham</td>
<td>enriched bread, mostly wholemeal</td>
</tr>
<tr>
<td>skinless chicken</td>
<td>green, leafy vegetables (broccoli, spinach, cabbage)</td>
</tr>
<tr>
<td>turkey</td>
<td>milk chocolate</td>
</tr>
<tr>
<td>white fish</td>
<td>dried fruit (prunes, apricots, raisins); fresh fruit soy (tofu, soybeans, soymilk)</td>
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Sources: Burke & Deakin 2000; Rockwell & Hinton 2005.
the dangers of iron deficiency in order to ensure that athletic performance and overall health are not compromised by poor iron status.

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References


Additional Resources
American Dietetic Association, www.eatright.org
Breaking News on Supplements and Nutrition (North America), www.nutraingredients-usa.com/
Ohio State Buckeye Sports Nutrition (Minerals), www.hec.osu.edu/sportsnut/nutrients/minerals.htm