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Take Control of Your Health

High Iron Levels Threaten Bone Health and Increase Fracture Risk

Analysis by Dr. Joseph Mercola | January 16, 2025

STORY AT-A-GLANCE

- High iron levels, particularly serum ferritin above 1,000 µg/L, significantly increase the risk of fractures, with vertebral fractures being most common. Managing iron levels is key to reducing this risk
- Both iron overload and deficiency weaken bones. Excess iron promotes osteoclast activity, leading to bone resorption, while insufficient iron impairs osteoblast function, disrupting bone formation
- Elevated iron levels adversely affect bone microarchitecture, compromising bone strength and increasing fracture susceptibility
- Excess iron leads to the production of reactive oxygen species, causing oxidative stress that damages bone cells and disrupts their function, further weakening bones
- If your ferritin levels are high, establish a regular blood donation schedule of two to four times per year to effectively remove excess iron from your body

Iron overload, often abbreviated as IO, presents a significant risk factor for fractures. Conventional treatments for IO, such as phlebotomy and iron chelation therapy, aim to reduce iron levels but come with their own set of challenges. Phlebotomy, for instance, involves regular blood removal, which is inconvenient and uncomfortable for patients. Iron chelation therapy, while effective, leads to side effects like gastrointestinal disturbances and kidney issues.

The underlying causes of IO are diverse and complex. Hereditary hemochromatosis (HH) is a genetic disorder that leads to excessive iron absorption from the diet. Other conditions, such as thalassemia and sickle cell disease, also result in iron overload due to frequent blood transfusions.

Chronic liver diseases, including hepatitis C and nonalcoholic fatty liver disease, contribute to elevated iron levels as well. Additionally, postmenopausal women may experience increased iron stores due to hormonal changes. These underlying causes disrupt your body's iron regulation, leading to IO.

In HH, mutations in the HFE gene cause the body to absorb more iron than needed, resulting in accumulation in organs like the liver and heart. In thalassemia and sickle cell disease, repeated blood transfusions introduce excess iron, which the body cannot excrete efficiently. Chronic liver diseases impair the liver's ability to produce hepcidin, a hormone that regulates iron balance, further exacerbating iron accumulation.

Diagnosing IO is challenging due to the variability in symptoms and the overlap with other conditions. Many individuals with IO remain undiagnosed until significant organ damage occurs.

Iron Overload Significantly Increases Fracture Risk

A population-based matched cohort study investigated the relationship between iron overload disorders and the risk of bone fractures, aiming to determine whether elevated iron levels significantly increase the likelihood of fractures among affected individuals.[1]

The study included 20,264 patients diagnosed with iron overload and 192,956 matched control participants. The population consisted of adults over 18 years old, with an average age of 57, and approximately 40% were female. The findings revealed a 55% increased risk of fractures among patients with iron overload, with the highest risk observed for vertebral fractures.[2]

Specifically, patients with serum ferritin levels exceeding 1,000 µg/L, a marker indicating high iron in the blood, had a 91% increased risk of any fracture and a 2.5-fold increased

risk of vertebral fractures.[3] Notably, the study found no elevated fracture risk among patients without high serum ferritin levels. Additionally, the risk was consistent across both males and females, indicating that iron overload affects fracture risk similarly regardless of sex.[4]

One of the key biological mechanisms identified is that **iron overload** adversely affects both bone quantity and the microarchitecture — the tiny structures that make up bone. This deterioration compromises bone strength, making fractures more likely.[5] The study underscores the importance of monitoring serum ferritin levels as an indicator of fracture risk, especially in individuals with laboratory-confirmed iron overload.[6]

Moreover, the research highlighted that hereditary hemochromatosis, thalassemia major and sickle cell anemia are significant contributors to iron accumulation in the body. These inherited blood disorders disrupt iron regulation, leading to excessive iron storage and subsequent bone health issues.[7]

In fact, decreased bone mineral density was observed in over 70% of adults with sickle cell disease and over 60% of adult thalassemia patients.[8] Addressing iron overload effectively therefore helps preserve bone integrity and reduce the incidence of fractures in this vulnerable population.

Iron's Dual Impact on Bone Health

A review published in the journal Pharmaceuticals further explored how different levels of iron in the body influence bone health, particularly focusing on the roles of osteoclasts and osteoblasts — the cells responsible for breaking down and building up bone, respectively.

The researchers aimed to understand whether having too much or too little iron could disrupt the balance between these two types of cells, ultimately affecting bone strength and increasing the risk of fractures.[9] The review examined individuals with various iron-related conditions, including hereditary hemochromatosis, thalassemias and sickle cell disease.

A significant percentage of patients with these iron overload disorders exhibited decreased bone mass and an increased likelihood of bone fractures.[10] However, the findings revealed that both high and low iron levels negatively impact bone mineral density, leading to conditions like osteoporosis and osteopenia.

Delving deeper, the research highlighted that excess iron promotes the activity of osteoclasts, the cells that resorb or break down bone tissue. This heightened osteoclast activity accelerates bone loss, weakening the skeletal structure and making bones more susceptible to fractures.

On the flip side, insufficient iron levels also disrupt bone health by impairing the function of osteoblasts, the cells responsible for bone formation. This dual disruption further exacerbates the risk of developing osteoporosis and other bone-related issues.[11] The study also uncovered that elevated iron levels lead to the production of reactive oxygen species (ROS), which are chemically reactive molecules containing oxygen.

ROS contribute to oxidative stress, damaging bone cells and impairing their ability to function correctly. This oxidative stress not only hampers the formation of new bone by osteoblasts but also encourages the breakdown of existing bone by osteoclasts, creating a vicious cycle of bone deterioration.[12]

Biologically, the mechanisms by which iron affects bone health are intricate. Excess iron interferes with the differentiation and activity of osteoblasts by downregulating key genes like Runx2, which are essential for bone formation. Additionally, high iron levels enhance osteoclastogenesis — the formation of more osteoclasts — through pathways involving ROS and NF-κB signaling.

These processes collectively lead to increased bone resorption and decreased bone formation, undermining bone integrity and strength.[13]

In summary, maintaining balanced iron levels is necessary for bone health. Both iron overload and deficiency disrupt the delicate equilibrium between bone resorption and formation, leading to weakened bones and a higher risk of fractures. Understanding

these mechanisms underscores the importance of monitoring and managing iron levels to preserve bone strength and prevent osteoporosis.[14]

Simple Steps to Reduce Iron Overload and Protect Your Bones

Iron overload wreaks havoc on your bone health by disrupting the delicate balance between bone formation and breakdown. The good news? You have the power to address this issue through straightforward lifestyle changes that make a real difference in protecting your skeletal system. Here are four powerful ways to get your iron levels under control:

1. **Get your iron levels tested regularly —** You can have your iron levels checked using a simple blood test called a **serum ferritin test**. I believe this is one of the most important tests that everyone should have done on a regular basis as part of a preventive, proactive health screen.

   You want your ferritin level below 100 ng/mL, however the ideal range is 20 to 40 ng/mL. Below 20 ng/mL is an indicator that you are iron deficient. Aside from a serum ferritin test, a gamma-glutamyl transpeptidase (GGT) test is another screening marker for excess free iron and is a great indicator of your risk for sudden cardiac death, insulin resistance and cardiometabolic disease.

2. **Donate blood to lower excess iron —** Your body has a limited capacity to excrete iron, so it can easily build up in organs like your liver, heart and pancreas. This is dangerous because iron is a potent oxidizer that damages your tissues and contributes to a variety of health problems, including cancer.

   If your ferritin levels are high, establish a regular blood donation schedule of two to four times per year. This natural approach effectively removes excess iron from your body since blood loss remains the only way your body eliminates iron. Your contributions help others while protecting your bone health.

   You can also remove blood in smaller amounts once a month according to the schedule below. If you have congestive heart failure or severe COPD, you should

discuss this with your doctor, but otherwise this is a fairly appropriate recommendation for most. If, for some reason, a blood donor center is unable to accept your blood for donation, you can obtain a prescription for therapeutic phlebotomy.

Men	Postmenopausal Women	Premenopausal Women
150 ml	100 ml	50 ml

3. **Monitor your diet —** Avoid cooking in iron pots and pans, limit alcohol consumption, which increases iron absorption, and be cautious with iron-fortified processed foods. If you drink well water, install an iron precipitator or reverse osmosis filter to reduce iron exposure.

4. **Optimize your calcium and copper intake —** Adequate calcium intake reduces iron overload naturally. Focus on getting calcium from whole food sources rather than supplements. When calcium levels are low, your body releases more parathyroid hormone (PTH), which not only dissolves bone but also increases iron storage. Breaking this cycle through proper calcium nutrition helps protect both your bones and overall health.

   Iron and copper are also highly interdependent and need to be considered together. Iron overload along with copper deficiency is a dangerous combination. Most people are deficient in copper and need more in order for their iron metabolism to function properly.

   Depending on your copper levels, you may need to take up to 3 milligrams (mg) to 4 mg of copper bisglycinate per day, or eat copper-rich foods, such as bee pollen, grass fed beef liver and acerola cherry.

   Acerola cherry is very high in vitamin C, which contains copper-rich tyrosinase enzyme. Retinol, which makes copper bioavailable, is also important. It's found in beef liver and beef organs.

Sources and References

- [1, 2, 3, 4, 5, 6, 7, 8] The Journal of Clinical Endocrinology & Metabolism November 18, 2024, dgae807
- [9, 10, 11, 12, 13, 14] Pharmaceuticals 2018, 11(4), 107