MERCOLA
Take Control of Your Health

The Poorly-Understood Role of Copper in Anemia

Analysis by Dr. Joseph Mercola Fact Checked | September 11, 2022

STORY AT-A-GLANCE

- Iron and copper are highly interdependent and need to be considered together. If you don't have enough copper in your diet, hemoglobin production becomes impaired, along with many other aspects of iron metabolism
- Being anemic does not automatically mean that you're iron deficient. Anemia typically relates to impaired iron recycling, not deficiency, and impaired iron recycling is caused by copper and retinol deficiency
- The best way to lower excess iron is to donate blood, one to four times a year. Most adult men and postmenopausal women have high iron and could benefit from regular blood donation, as high iron is extremely toxic and destroys health. An even better strategy is to remove smaller amounts of blood every month
- To raise your copper level, you could use a copper supplement, but foods like grass-fed beef liver, bee pollen and whole food vitamin C are better
- If you're a farmer or grow your own food, the best way to put copper back into the soil, to get it into the food, is to add copper sulfate. Before you plant, simply spray the soil with copper sulfate, 10 to 15 pounds per acre, or use a copper sulfate foliage spray

Morley Robbins, MBA, CHC,[1] a repeat guest, is the founder of the Magnesium Advocacy Group. He's best known as the Magnesium Man, and is the author of "Cu-RE Your Fatigue: The Root Cause and How to Fix It on Your Own," in which he explains the roles of magnesium, copper, iron, vitamins A and D and other essential nutrients.

His Root Cause Protocol[2] is the implementation of that information. We're currently planning to write a book together, which will focus on the little-understood importance of copper and its interaction with iron.

As explained by Robbins, if copper is lacking in your diet, iron will build up in your liver, which changes its physiology and immunoproperties. Liver metabolism is highly dependent on copper and retinol, and there's not a lot of awareness of that.

> *"It's a very sophisticated process of interaction between copper and iron, and if that interaction doesn't go well, iron is going to start to accumulate in the tissues. It's going to start in the liver, but it's going to go elsewhere too,"* he says.
>
> *"I think that is kind of the takeaway of these conversations — to make sure people know that iron does accumulate, and that iron can be reduced through blood donations. Especially as you get into your 50s, 60s, 70s, it needs to be a regular part of your health routine."*

Three Ways to Measure Iron Status

The clinical term for excess iron in the liver is hemosiderosis, and it's so pervasive as to be near-universal. But where does the excess iron actually come from? And why is it that many with high iron stores have low serum ferritin?

As Robbins explains, oftentimes, low serum ferritin is not at all a sign of iron deficiency, but rather a deficiency in copper and retinol. The deficiency in copper basically locks iron in the liver and prevents it from being recycled as it should:

> *"It's important for practitioners to not measure iron status with just one marker. I think a lot of practitioners are falling into that trap of just using serum ferritin. There are three key ways to measure iron status: Hemoglobin, serum iron and serum ferritin.*

The biggest concentration of iron in the body is in our hemoglobin; 70% of the iron is in our red blood cells ... Hemoglobin is essential to understand what is going on with the biggest bulk of iron.

The second marker that I really focus on is called serum iron. It's less than 1% of the iron, but it's a very important measure of iron because it's really getting at the iron recycling program. Every second of every day, we have to turn over 2.5 million red blood cells. That's a lot of activity. In the course of 24 hours it's 200 billion red blood cells that need to be turned over.

But what's a surprise is to learn that only 25 milligrams (mg) of iron are needed to support that 24-hour cycle, but 24 of those 25 milligrams, 95% of the iron, is coming from this recycling program. So, it's a very significant understanding that the serum iron only represents a small percent, but it represents the efficiency of the iron recycling."

Ideally, hemoglobin should be between 12.5 and 13.5 for women, 14.5 to 15.5 for men. Serum iron should ideally be about 100 for women and 120 for men. The closer serum iron is to these, the more efficient your recycling is.

What You Need to Know About Serum Ferritin

The third iron measure is serum ferritin. There are four different types of ferritin in your body, broadly categorized as heavy chain and light chain. Heavy chain ferritin refers to ferritin protein inside cells and mitochondria that require copper to work properly. Serum ferritin refers to ferritin in your plasma, is outside the cell — and also outside the red blood cells, the hemoglobin.

"What is not well-known is that this ferritin that shows up in the blood is very iron-poor. It doesn't have iron in it. The iron has been discharged in the liver and then the protein gets secreted out ... So, serum ferritin is not representative of iron per se. The iron was discharged in the liver ...

I would never use ferritin only as an indication of iron status. You need to see hemoglobin, serum iron, and serum ferritin. You need to see them in relationship to each other ...

[When] serum ferritin starts to get high, it's highly correlated with inflammation or an infection. And again, it makes sense. The liver is taking it on the chin. Iron is not being metabolized properly. Pathogens might be involved. And so, the body starts to secrete the ferritin in a more significant way ...

Serum ferritin should be between 20 and 50. That seems to be a nice sweet spot for people. When the serum ferritin begins to get up in the hundreds, there's a significant likelihood that there's pathology in the liver that's causing that ...

For women, the serum ferritin red flag goes up at 150. For men, the red flag goes up at 300. It can go up into the 5,000s and even higher, with severe chronic disease and inflammation ...

Low ferritin is an indication of metabolic breakdown in the spleen ... it's some kind of parasitic dynamic that's affecting protein production. The ferritin protein is not getting transcribed properly ...

So, low ferritin ... means low recycling. Something in the iron recycling system is out of balance and needs attention. I would argue that, almost without exception, it's a lack of bioavailable copper. The spleen organ is intensely copper dependent. The liver intensely copper dependent. That's not well known in clinical circles."

So, to summarize, one of the most common errors doctors will make is to prescribe iron pills when serum ferritin is low. More than likely, what's needed is copper, retinol and other factors to support iron recycling. Unfortunately, articles and textbooks on iron metabolism rarely if ever mention the copper side, even though copper plays a far more important role in the recycling of iron.

Why Blood Donation Is so Important

Most all men and non-menstruating women have excess iron. The reason for this is because many foods are fortified with iron, and your body has no excretory system for iron besides blood loss. So, it accumulates, and if the recycling mechanism doesn't work properly, the iron gets lodged in tissues.

This is why regular blood donations are so important. Less iron means less oxidative stress, which is going to create less metabolic dysfunction, which results in fewer health problems and less tissue damage.

Every day you're alive, your body accumulates about 1 mg of iron. Add up 1 mg of iron for every day of your life, and you'll realize you won't be able to eliminate all of it even if you tried. When you take out one unit of blood (500 cc), you remove about 250 mg of iron.

If donating a full pint (half a liter, 500 ml or about 8 ounces) of blood three to four times a year is problematic, you can remove blood in smaller amounts once a month on the schedule listed below.

Men	150 ml
Postmenopausal Women	100 ml
Premenopausal Women	50 ml

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. I personally remove 60 cc or 2 ounces of blood once a week, which is about 7 pints per year. This is a large amount but because it is done slowly it is far better tolerated. Robbins adds:

> *"I think what's amazing is the sheer simplicity of doing a blood donation, and what it does to revitalize the body. When you have that blood loss, it trips a wire*

for erythropoietin, a very important hormone that triggers the production of new red blood cells.

And the beauty is it actually has two signals. The second signal is, let go of the iron in the tissue. It has a very powerful effect of releasing the iron to get it back down to the bone marrow, where it's needed to make the new red blood cells."

Hepcidin and Hemosiderin

To fully understand iron metabolism, you also need to understand the roles of hepcidin and hemosiderin. A ferritin protein can hold as many as 4,500 atoms of iron. Each iron atom has four unpaired electrons, which causes oxidative stress. Hemosiderin, an iron-storage complex composed of partially digested ferritin and lysosomes, can hold 10 times more iron than ferritin.

This also means it holds 10 times more unpaired electrons. When hemosiderin builds up in your tissue, that's when you start having serious issues with iron regulation.

"What's wildly confusing is hepcidin, [which is encoded by] the HAMP gene," Robbins says. *"Hepcidin is an antimicrobial peptide. So, it's got some connection to pathogens. And what's it trying to do? Hepcidin is trying to get iron out of the circulation, to get it away from the pathogens. But it's a bit of a slippery fish because it reacts to iron status. It reacts to inflammation status. It reacts to hormonal status.*

Estrogen and testosterone have significant influence over hepcidin. It's reacting to copper status ... Elevated levels of active hormone D [vitamin D] can suppress hepcidin. Retinol deficiency can increase hepcidin ...

The key is understanding that this constant recycling system of the red blood cells, the iron doorway, is being opened by a copper doorman. And if copper isn't doing its job, we're going to have a problem. And what is hepcidin's job?

Hepcidin shuts down the iron doorway. So, we have this significant dynamic between this very important iron egress that needs bioavailable copper, and if bioavailable copper's not there, this hepcidin protein is going to shut it down.

That's where a lot of the confusion is because the true anemia that exists on the planet isn't one of iron deficiency. It's one of copper deficiency not allowing for proper iron recycling. That's a very important nuance.

And the misunderstanding is that iron may look low in the blood, ferritin looks low or hemoglobin looks low, serum iron looks low, but it's high in the tissue. There's no blood test that measures iron status in the tissue."

Excess Iron Can Cause Dysfunction in Many Organs

A colleague of Robbins in Miami, Florida, has developed a way to measure iron in the liver and brain using a Tesla 2 MRI and a novel scoring technique. This technique was catalyzed by my previous interview with Robbins, because the doctor in question was initially skeptical, but after measuring his own liver iron, he was shocked at the amount stored in there.

But iron is also stored in other organs, including your heart, which can have serious consequences. Robbins explains:

"Jerry Sullivan, a pathologist — his real focus was on cardiology — developed what became known as the iron heart hypothesis. It's not a very popular thesis with cardiologists, but he was able to prove that it was accumulation of iron in the heart muscle cells that were causing the wide spectrum of all the issues, whether it's atrial fibrillation, enlarged heart, any kind of myocardial infarct.

He was able to link it back to the accumulation of iron, and what that was doing to kill energy production in that incredibly important organ in our body. So, the accumulation of iron in our organs is very significant, because these organs are supposed to be producing energy to do their function ...

> *Too much iron syncs up with the symptoms that are laid out in the Merck Manual. You can trace just almost every one of them back to this iron-copper dysregulation, because copper's supposed to be regulating the iron. And when it doesn't do that, it starts to accumulate ... and then cause dysfunction and dysregulation in the body."*

Food Supply Nearly Devoid of Copper

As mentioned, iron recycling depends on copper and retinol, both of which are lacking in our food supply, thanks to depleted soils. Copper is further eliminated through processing and refining. Making matters worse, our food supply is chockful of iron, sugar and seed oils (which are loaded with linoleic acid) and this triad suppresses copper and retinol function.

For these reasons, copper supplementation can be a good idea, especially if you're anemic, in addition, of course, to reducing or eliminating iron, sugar and seed oils.

> *"My new phrase, and I don't know whether it's going to get traction or not, but I'm coming to the opinion that sugar is white iron,"* Robbins says. *"People don't realize how glucose metabolism influences iron metabolism, especially accumulation of iron, and it's absolutely staggering when you get into it.*
>
> *So, I think it's important for people to just be aware that sugar isn't just bad, it's really bad. And I think the coupling with the linoleic acid, it's out of control."*

Facts About Retinol

Retinol is vitamin A, which is not the same as beta carotene. They are two different distinct molecules, not to be confused, although nutrition labels get away with conflating beta carotene with vitamin A. Vitamin A also should not be confused with retinyl palmitate.

What people believe is “vitamin A toxicity” is actually a sign of iron toxicity in the liver, caused by copper deficiency. What happens is, when you get vitamin A from your diet, be it cod liver oil, beef liver or free range eggs, the retinol is turned into retinyl palmitate and gets stored in the stellate cells in your liver.

To function properly, the retinyl palmitate then needs to be turned back into retinol, so it can be transported on the transthyretin (TTR) protein, composed of T4 and retinol. Without the retinol, TTR becomes destructive. While Robbins cannot prove it yet, he’s convinced that copper is required for the conversion of retinyl palmitate to retinol.

> *“And while we're talking about retinol, it's probably important for people to know [that] retinol as a key component of the movement of electrons from complex 3 to complex 4. The electron actually rides the back of the retinol structure. That alone is mind blowing to think about that.*
>
> *If retinol is not in our diet, then it's not in our electron transport chain, then it's not able to support the optimal generation of energy. So think of retinol as an energy-focused nutrient. It's very unusual, because most of its [known benefits are] around immune system or vision.”*

Retinol is best obtained through whole foods, such as cod liver oil, beef liver, free range egg yolks (the deeper orange the yolk, the more retinol it contains), cacao and hot cocoa, and organic grass fed butter, ghee and heavy cream.

More on Copper

Copper also plays an interesting role in energy production. Your mitochondria produce melatonin in response to natural sunlight, and melatonin in turn catalyzes and upregulates glutathione, which is important for energy production, antioxidant protection against free radical damage and more.

As explained by Robbins, glutathione is also the “greeter” of copper in the cell’s cytoplasm. There are two metabolic steps to make glutathione, and one of the steps involve cysteine, which has a very tight relationship with copper.

Furthermore, a copper-dependent enzyme is required to convert serotonin into melatonin. Copper is also instrumental in regulating immune function. All of these functions are yet more reasons to make sure your copper level is optimal.

How to Optimize Your Copper Level

As for raising your copper intake, it's best to get your copper from food and not a supplement. Good sources include bee pollen, grass fed beef liver and other organ meats. You also want plenty of saturated fats in your diet, as copper is a fat-soluble mineral. If you don't have fat in your diet, your ability to absorb copper plummets.

If you do opt for an oral supplement, Robbins suggests 3 to 4 mg of copper bisglycinate per day, taken with a fatty food (as it's a fat-soluble mineral). The upper tolerable limit is 10 mg. This is so good because it has no charge on the molecule and readily penetrates cell membranes.

If you're a farmer or grow your own food, you can put copper back into the soil, to get it into the food, by adding copper sulfate. Before you plant, simply spray the soil with copper sulfate, 10 to 15 pounds per acre. Alternatively, use a copper sulfate foliar spray, which is what I do.

Most farmers merely use NPK (nitrogen, phosphorous and potassium) fertilizer and NPK actually blocks copper uptake in the plants, which was highlighted by Andre Voisin, Ph.D., in his 1957 classic (which, sadly, is now out of print): "Soil, Grass & Cancer."

Vitamin C Can Help Augment Copper Level

Whole food vitamin C can also boost your copper level, as vitamin C contains an enzyme called tyrosinase, which has 2 atoms of copper in it. Acerola cherry is one excellent source. A single acerola cherry contains about 80 mg of whole food vitamin C. Ascorbic acid is prooxidant, while vitamin C complex is actually an antioxidant. Anything that has copper is going to be antioxidant.

Do not make the mistake of taking ascorbic acid, however, as it is NOT the same as whole food vitamin C. If you were to compare the two to a car, vitamin C would be the whole car, fully functional, and the engine is an enzyme called tyrosinase, while ascorbic acid is the car frame, with no moving parts.

Importantly, ascorbic acid chelates copper out of tyrosinase, which is exactly what proton pump inhibitors do. It's my view that ascorbic acid is a "pharmacomimetic." While it's a natural molecule, it has drug-like effects. It acts differently from vitamin C because it's been taken out of the vitamin C complex. For example, ascorbic acid does not prevent or treat scurvy. Only whole food vitamin C does.

Ascorbic acid was identified by two scientists who also discovered ceruloplasmin, the major copper-carrying protein in your blood, and ascorbic acid can affect the structure and the copper composition of this crucial copper protein too.

The ideal ratio of copper to ceruloplasmin is copper around 100, and ceruloplasmin at 30, giving us a ratio of 3.33. If that ratio starts to rise or fall, then you likely have some kind of pathology going on.

A ratio in the fours and fives is often indicative of inflammation or an infection of some sort. When it starts to drop precipitously, it's a clear sign that there isn't adequate copper to fuel the function of ceruloplasma protein. So, to summarize the key take-home, if you're going to take vitamin C, use whole food vitamin C, not ascorbic acid.

More Information

If you missed our last interview, where we went deep into iron metabolism and recycling, you can **find it here**. You can also learn more on Robbins' website, **RCP123.org**, which stands for Root Cause Protocol.

> *"We have an RCP community that you can join, where every other week we have Q&As. People get to ask questions and we do our best to answer them. And then we offer **training through the RCP Institute**. We're about halfway through the class now. Historically, we've had 20 or 30 students in each class.*

It started to creep up, and this class is 220 students. So, word is getting out. And it's a very switched on group of people. I'm absolutely blown away by the caliber. But we have intakes and the classes are in the beginning of the year and then the second half of the year, for 16 weeks."