

Zinc-Copper Imbalance - Part Four

Highest dietary sources of copper

Food	Amount (mg per 200 cal)
Clam	39
Beef/lamb/goose liver	14-17
Oysters	13
Fresh basil	3
King crab	2
Sesame butter	1
Ham	1
Cashews	1
Octopus	1
Chestnuts	1
Chicken liver	1
Whitefish	1

I've listed the best dietary sources of copper on this slide. Not surprisingly, shellfish, organ meats, and spices top the list, as they so often do. They are real nutrient powerhouses. Clams are the highest by far with 39 mg per 200-calorie serving. Then beef, lamb, and goose liver are next with 14 to 17 mg per serving. Oysters are really pretty high as well, with 13 mg per serving, fresh basil is next at 3, then crab at 2, and sesame butter at 1. As you can see with this chart, there really aren't a lot of other great sources of copper in the diet that even come close to matching seafood and organ meats, and it's not difficult to understand how someone could become deficient.

Notice also what is not on the list here: muscle meat and eggs. I've said this in a few different places. To some extent, it might be better if a patient, or you for that matter, was a vegetarian primarily who ate organ meats and seafood than eating a Paleo diet with no organ meats and seafood because muscle meats, while they are a great source of many nutrients, are lacking in some important nutrients, and copper is one of them. This is why I'm always hammering on about the importance of organ meats and shellfish in the diet.

Also remember that high intake of iron-rich foods, so, for example, muscle meats, can block copper absorption, so it's possible for people on a Paleo-type diet to get a lot of iron but not get enough

copper. Of course, clams and oysters both do have significant amounts of iron, but the amounts of copper in these foods are so high that they are still a good source despite the high iron levels.

USDA recommended Zn intake by population

Population	Amount (mg)
Infants (0–6 months)	2
Children (7–12 months)	3
Children (1–3 years)	3
Children (4–8 years)	5
Children (9–13 years)	8
Adolescents (14–18 years)	9 (girls), 11 (boys)
Adult men	11
Adult women	8
Pregnant women	11
Breastfeeding women	12

Similar story for zinc. Since we don't have a reliable biomarker, especially for marginal deficiency when serum zinc levels are low, it is difficult to determine whether it is from inflammation, marginal deficiency, or both. Controlled trials of moderate zinc supplementation have demonstrated that marginal zinc deficiency contributes to impaired physical and neuropsychological development and increased susceptibility to life-threatening infections in young children. The study we discussed earlier showed that zinc supplementation improved symptoms even with normal zinc levels. A recent study in pigs showed that even marginal zinc deficiency can cause digestive distress. However, given the fact that zinc supplements can cause copper deficiency, copper deficiency is already possibly more common than acknowledged, and that there are no reliable markers for detecting mild copper deficiency, I believe that getting zinc from food rather than supplements is the best course of action in most cases.

Populations at risk for zinc deficiency include vegetarians, who require up to 50 percent more zinc than omnivores because of the nutrient inhibitors in plant-based foods; people with GI malabsorption, including celiac and IBD; children and adolescents; pregnant and breastfeeding women; elderly; and alcoholics. Signs and symptoms of zinc deficiency include poor neurological function, weak immunity, diarrhea, allergies, autoimmunity, thinning hair, intestinal permeability, acne, and rashes.

Highest dietary sources of zinc

Food	Amount (mg per 200cal)
Oyster	265
Veal liver	17
King crab	16
Lobster	10
Beef, chuck	10
Lamb, shank	10
Endive	9
Beef, brisket	9
Mushrooms, crimini	8
Broccoli rabe	7
Bison, ground	6

These are the top sources of dietary zinc, and again, the theme continues. Shellfish are incredibly nutrient dense, sometimes more than organ meats, as is the case with both zinc and copper. In this case, oysters top the list by a wide margin, 265 mg per 200-calorie serving, with veal liver being the next highest source at 17, crab at 16, lobster at 10, muscle meat (beef) at 10, and lamb at 10. Then endive is actually pretty high at 9, and mushrooms are the next highest plant source at 8.

Remember, high zinc intake, such as 40 to 50 mg of supplements, 10 mg of diet, has been shown to cause copper deficiency. The recommended upper limit for zinc intake is 40 mg per day, combined with supplements and food, for adults and lower for kids, and you can see the Linus Pauling page on zinc for more detail on the upper limits. This is why I recommend dietary intake alone in most cases, if the patient is willing to eat shellfish and organ meats. Given the extremely high zinc content of oysters, for example, a single 200-calorie serving of oysters would more than meet zinc needs for the entire week, and you wouldn't want to and don't need to eat oysters every day, probably for that reason. That said, the body does have mechanisms for regulating zinc intake from food, and toxicity from excess zinc in food is rare except in cases of genetic predisposition.

Who should supplement?



Vegetarians and vegans, or those that can't eat foods rich in Zn or Cu



People with significant **zinc and copper deficiency**



People with **GI absorption issues**

What about supplementing with zinc and copper? In general, I prefer that patients get these nutrients from diet for the reasons that we've already talked about, but there are some situations in which supplementation may make sense. One is with vegetarians and vegans. Most foods that are high in copper and zinc are animal foods, as you've seen, and those plant foods that do contain zinc and copper are not as well absorbed, which is another issue. People with frank copper and zinc deficiency may also want to supplement, but remember, low serum copper is an expected finding in Wilson's disease, which is a copper-toxic condition, so if you see low serum copper, make sure to test 24-hour urine copper and ceruloplasmin before you consider copper supplementation.

Some studies have shown that moderate zinc supplementation such as 11 mg per day, an amount that you could easily get from just eating a 200-calorie serving of oysters once a week, improves zinc-to-copper ratio, oxidative stress, and immunological parameters. When you do supplement, I recommend supplementing with both nutrients to reduce the risk of toxicity of one nutrient or inducing deficiency of the other.

Recommended zinc dosage

Population	Amount (mg)
Low background intake	Up to 30 mg/d
Moderate background intake	Up to 15 mg/d
Maintenance dose	10–15 mg/d

For zinc, the dose that you supplement with would, of course, depend on background dietary intake. If the patient is a vegan or vegetarian, the background intake is likely low, and the patient may tolerate up to 30 mg per day, but I wouldn't go higher than this given that higher doses of zinc have been shown to induce copper deficiency. For an omnivore eating zinc-containing foods, I would limit to 15 mg per day. In both cases, you would retest serum zinc levels after 60 to 90 days. Unfortunately, you cannot completely rely on a change in serum levels because, as I mentioned before, serum zinc is not all that sensitive to dietary intake, but some studies do show that serum zinc will respond to supplementation and at least give you some idea of what is happening.

After the therapeutic goal has been achieved, I suggest dropping supplementation entirely and advising patients to get zinc from food. In the case of vegetarians and vegans who aren't consuming foods that are high in zinc, a maintenance dose of 10 to 15 mg of zinc per day is probably a good idea. Studies have shown that doses up to 15 mg per day do not change biomarkers of copper status over a four-month period, so that suggests that that dose is safe and probably doesn't cause copper deficiency, although, as we know, the biomarkers for detecting mild copper deficiency are not particularly reliable, so it's possible that patients in those studies were experiencing copper deficiency, but the markers were not picking it up. I think a cautious approach is the best option here.

The best form of zinc to supplement with is glycinate. It has good absorption and minimal gastrointestinal side effects.

Recommended copper dosage

Population	Amount (mg)
Low background intake	6–8 mg/d
Moderate background intake	2–4 mg/d
Maintenance dose	1–2 mg/d

For copper, the recommended daily intake is about 1 mg for adults and 1.3 mg for pregnant and breastfeeding women. The upper limit again, according to the USDA, is 10 mg per day, but as we saw, research suggests it should be higher, up to 50 mg per day. The supplement dose should depend on the background intake, just as with zinc. If copper intake is low, I'd suggest 6 to 8 mg per day. If copper intake is moderate, I'd suggest 2 to 4 mg per day, and then a maintenance dose of 1 to 2 mg per day for those who are unable to eat foods that are high in dietary copper may be warranted, especially if they are supplementing with zinc.

Unfortunately, as we've discussed, serum copper is a pretty worthless marker for detecting changes in supplementation and mild-to-moderate deficiency and excess, so again, a cautious approach is warranted.

Okay, that's it for now. Next up, we'll talk about magnesium. See you then.