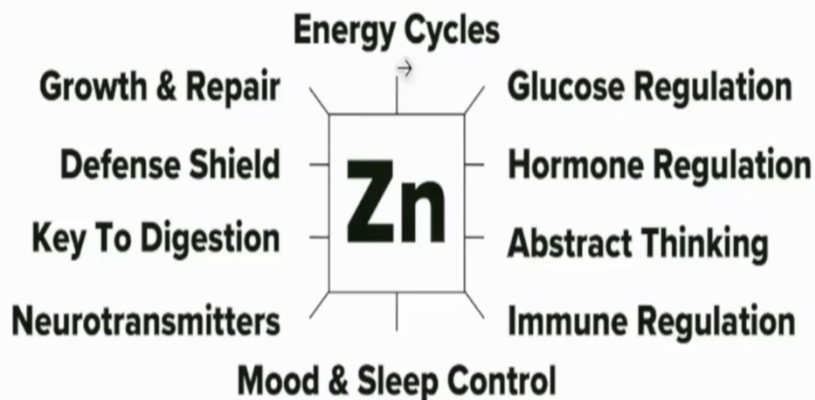


## Zinc

**DISCLAIMER:** the following is not meant to treat anyone with advice or tell you what you should do, such as relative to use of medication, exercise, or changing your diet. The information in this handout is merely offering what has been published in the research literature, as well as based on my professional experience. Talk to a doctor or other appropriate professionals as to what is best for your own specific needs.

It should also be appreciated that everyone has their own perspective on how to improve health. Nutritionists do it through food. Physicians do it through medicine. Psychologists do it through changing thoughts, feelings, and behaviors. Consequently, what is offered here is a reflection of my own bias and perspective.

What it does:



Zinc has many important roles as can be seen here.

[www.htmavirtualsummit.com](http://www.htmavirtualsummit.com) "Zinc: the spiritual warrior" Robert Selig

It is a mineral and antioxidant that helps boost the immune system such as natural killer and T cells and can be found in cold and flu remedies such as Zicam and lozenges. It also helps to make proteins and DNA. Zinc is also involved in neurological function, fertility and reproduction.

The greatest concentration is found in the prostate which includes it being part of seminal fluid. Three common prostate diseases are prostatitis (an inflammation affecting younger men more than older ones), benign prostatic hypertrophy (BPH; affecting older men more), and prostate cancer. In one study of 200 men having prostatitis not caused by bacterial infection zinc supplements relieved the symptoms in 70% of them. In a small study on BPH, zinc supplements brought relief to all 19 men and returned the prostate to a normal size in 14 of the 19. The amount used was 50-150 mg/day.

The second greatest concentration is in the pancreas including the beta cells - meaning it has an important role in blood sugar regulation including being in insulin. When insulin is released from the beta cells there is a loss of zinc. Zinc deficiency prevents adequate production of insulin.

Research has found that the pancreatic tissue of diabetics contains a third of the zinc concentration of controls.

A meta-analysis of 36 studies involving over 1700 people from 14 countries found taking a zinc supplement significantly lowered fasting glucose levels in people with type 2 diabetes along with those not yet diagnosed but at high risk for becoming diabetic. (The American Journal of Clinical Nutrition, “Zinc supplementation improves glycemic control for diabetes prevention and management: a systematic review and meta-analysis of randomized controlled trials” Xinhui Wang et al, July 2019). Up to 86% of zinc in the body is in muscle and bone, and muscles have the third highest concentration of the mineral. Zinc is stored only briefly in the blood and bone and is quickly excreted through urine and bowel. Hence daily intake of it is important.

Other functions for zinc include:

- ❖ heart health
- ❖ protecting cells from oxidation
- ❖ maintaining bone. Zinc is important for normal skeletal growth, bone homeostasis, and may promote bone regeneration. Low serum levels of zinc are associated with osteoporosis.
- ❖ cognitive function
- ❖ metabolism of fatty acids
- ❖ metabolism of vitamin A, meaning it needs zinc for it to work such as for night vision.
- ❖ increasing testosterone in both men and women. It increases testosterone directly, and also suppresses the aromatase enzyme that changes testosterone to estrogen, so it helps conserve what already exists. Aromatase can cause more belly fat to arise in the process, especially in men. Zinc blocking aromatase can interfere with such fat production. It is also important for sperm and semen production. In postmenopausal women use of zinc increased sexual desire, arousal, orgasm, satisfaction, and vaginal moisture. Zinc can also help block the conversion of testosterone into DHT (dihydrotestosterone) which can lead to male pattern baldness. Zinc deficiency has been linked with a dip in testosterone levels (hypogonadism). Having sufficient zinc can help with erectile dysfunction. It can help promote optimal fertility in women and reduce menopause symptoms.
- ❖ maintaining vision (e.g. there have been a number of studies looking at zinc supplementation and macular degeneration. Some research suggests it does not prevent the development of it but might reduce the progression to advanced macular degeneration. The AREDS (age-related eye disease study) and AREDS2 found that zinc plus other nutrients like antioxidants helped reduce the risk of developing the disease. It used 80 mg/day of zinc oxide, which is said to be the least well absorbed form, along with 2 mg of copper given too. They said there were no adverse effects from the zinc. But there was actually a 30% increase in self-reported anemia. There was also an associated significant increase in people being hospitalized for genitourinary problems. Blurry vision may also result from a deficiency. Zinc is highly concentrated in the retina and is involved in bringing vitamin A from the liver to the retina to produce melanin which is a protective

pigment in the eye. Without enough zinc, you are at greater risk for having dry eyes and cataracts.

- ❖ carbohydrate metabolism
- ❖ macronutrient metabolism
- ❖ maintenance of skin, hair and nails
- ❖ protein synthesis
- ❖ acid-base metabolism
- ❖ insufficiency can cause intestinal inflammation. Getting more zinc can tighten leaky gut in Crohn's, and enhance epithelial barrier function even in non-disease states. Having more zinc reduces inflammation including in the GI tract.
- ❖ it has antimicrobial properties that help regulate the growth of beneficial bacteria while inhibiting the growth of pathogens.
- ❖ it is needed to synthesize chemicals such as serotonin, dopamine, norepinephrine, thyroid hormone, and melatonin. It is involved in the transformation of tryptophan into serotonin into melatonin, and so can promote better sleep. Zinc also helps with the balance between glutamate and GABA which have an impact on sleep. It also makes adenosine (a part of ATP, the fuel for cells). As adenosine builds up during the day it creates sleep pressure that pushes you into a deep sleep. While sleeping the adenosine breaks down and you become awake again.
- ❖ you also need thyroid hormone to absorb zinc, and having too little zinc can lead to hypothyroidism. Proper zinc helps with thyroid hormone production and weight management.
- ❖ atrophy of the thymus gland can result from zinc deficiency. The thymus is involved with the immune system so that a person becomes more susceptible to infections. Duration of infections can become a lot longer with such deficiency.
- ❖ zinc deficiency has been associated with more severe covid-19 disease and mortality, although there is no evidence that taking a supplement prevents contracting the virus. However, zinc needs a transport molecule to get into cells to do its preventative work. Natural transporters include quercetin (a vitamin C bioflavonoid), and the chemical EGCG which can be obtained from drinking green tea. (Hydroxychloroquine works the same way, by transporting zinc.)
- ❖ a lot of zinc is found in the pituitary gland which promotes the secretion of growth hormones. Growth hormone is obviously important in childhood years. But in middle aged and older people it also plays an important part as to burning fat and maintenance of muscle.
- ❖ in women with PCOS zinc supplementation is said to have a positive effect including insulin resistance and lipid balance. Some research found that 8 weeks of zinc sulfate supplementation significantly decreased triglyceride, total cholesterol, LDL and VLDL cholesterol concentrations (Experimental & Clinical Endocrinology & Diabetes, Effects of zinc supplementation and lipid profiles in women with PCOS: a randomized, double-blind placebo-controlled trial, "F. Foroozafard, et al, 2015; and Journal of Cardiovascular Research, "Effect of zinc supplementation on cardiometabolic risk factors in women with PCOS" Fatemeh Pouretymour Fard Tabrizi et al, 2010)

- ❖ in primary dysmenorrhea, zinc supplementation before and during each cycle seems to help reduce the intensity of pain.

Zinc and copper also need to be in balance, and having excess zinc depletes copper which can leave you more susceptible to sickness and feeling fatigued. But the opposite is also true, where too much copper impacts zinc levels adversely. One study looked at zinc to copper ratios relative to anxiety. It found that significantly higher levels of copper, and lower levels of zinc significantly associated with anxiety. A minimum treatment for 8 weeks of zinc and vitamin B-6 being given to anxiety patients resulted in normalized zinc and copper:zinc ratio along with anxiety symptoms decreasing by 31%. Similarly, girls hitting puberty have a rise in estrogen and copper levels, and thus their need for more zinc. This may explain anorexia, which hits girls vs. boys at the rate of 10:1. One study noted that “zinc deficiency and anorexia nervosa are remarkably similar, and a number of studies have demonstrated that there may be a positive correlation between zinc therapy and the rate of recovery of anorexia nervosa patients. [Given] the low toxicity of zinc, zinc supplementation should be included in the treatment protocol for anorexia nervosa.” (Eating Weight Disorders, “Zinc supplementation in the treatment of anorexia nervosa” J.C. Su et al, March 2002).

These two minerals can act like neurotransmitters in the brain. When copper levels rise dopamine levels decrease and norepinephrine levels increase. So when these two minerals are out of balance to each other problems can develop such as hyperactivity, ADHD, depression, autism, and even paranoid schizophrenia. Zinc deficiency can also cause low serotonin levels.

One researcher, Dr. David Watts, looked at thousands of trace mineral reports of women. He found that a pattern of elevated boron, copper and calcium along with lower levels of zinc occurred in women with breast cancer. His take is that boron and copper make the body more sensitive to estrogen and less responsive to the quieting effects of progesterone. Zinc aids in the production and utilization of progesterone. So the above pattern makes women less responsive to progesterone and more estrogen sensitive. Increasing zinc levels and lowering boron, calcium and copper can help create greater hormonal balance in such women. One study that was double-blind, randomized, and placebo-controlled gave women either a multi-vitamin alone, or a multi- with 7 mg of zinc daily for 10 weeks. Those who got the zinc had a significant reduction in anger-hostility and depression-dejection. (European Journal of Clinical Nutrition, “Effect of zinc supplementation on mood states in young women: a pilot study” T. Sawada et al, March 2010).

It should be realized that copper is not the only mineral that may take a hit from zinc. Research on other metals may not be as good such as for chromium and molybdenum that may be adversely impacted by zinc supplementation. Some recommend that zinc supplementation on a long-term basis be limited to no more than 20 mg/day unless other trace minerals are taken too. The association of zinc to depression may be its greatest psychiatric impact according to some (Frontiers in Pharmacology, “The emerging role for zinc in depression and psychosis” Matthew Petrilli et al, June 30, 2017). An inverse relationship has been found between low zinc levels and larger amounts of depression (e.g. Nutrition Reviews, “Zinc: the new antidepressant” Cathy Levenson, Jan. 2006). There also has been several randomized controlled trials which found zinc

to be effective in improving mood for both depressed and healthy individuals. Zinc supplementation also has improved the mood of people with treatment-resistant depression in several studies. There is also research that zinc supplementation can increase BDNF (brain derived neurotrophic factor) which is thought to be a means of relieving depression. BDNF has many other important functions and has been called 'Miracle-Gro for the brain' such as growing new brain cells even in adults, and strengthening memory.

As to bipolar disorder and zinc there is less research than on major depressive disorder. But some research has found lower levels in the depressed phase and higher levels in the manic (Neuropsychiatry, "The role of zinc in mood disorders" Meihua Piao et al, 2017).

Symptoms of deficiency: (a general level of deficiency based on blood plasma is ~70 mcg/dl).

- ❖ the most common problem is said to be skin issues. In the least severe cases this might be dry patches of skin. In the most severe cases it can be really severe acne.
- ❖ hair loss, or thinning hair. (Others say this is the most common symptom of zinc deficiency.) It helps build the hair follicles that anchors hair to the scalp and helps it grow. Loss may be localized to certain areas, or diffuse and all over. Alopecia, unexplained hair loss is a sign of low zinc. It plays a key role in hair growth. It creates protein and keratin, makes DNA for hair cell division, and regulates thyroid hormones. If any of these don't work hair loss can occur. Hair may break more easily too.
- ❖ other common signs are sore throat, poor appetite, diarrhea (zinc deficiency can cause diarrhea, but chronic diarrhea can cause zinc deficiency and a downward spiral can then result).
- ❖ lower immunity. With low zinc the body cannot fight off infections as effectively, leading to more sickness and disease. This may become more of an issue during the cold and flu season.
- ❖ poor memory. Cells in the hippocampus, the memory center of the brain, die off when deprived of zinc.
- ❖ insomnia
- ❖ low energy
- ❖ sinus problems and allergies
- ❖ oral and/or stomach ulcers. Zinc helps repair damaged tissues.
- ❖ white spots or lines on the fingernails (which means there was a problem a few months ago, since nails grow slowly, maybe from eating refined carbs and sugar, or going on an alcohol binge, which deplete zinc. Stop eating sugar or take some zinc.)
- ❖ muscle loss
- ❖ cramping, bloating
- ❖ abdominal pain
- ❖ frequent head colds, pneumonia, respiratory infections. (Zinc helps build glutathione which is called 'the master antioxidant' that slows down aging and helps heal inflammation.)
- ❖ cold hands or feet



- ❖ unexplained weight loss. Zinc is involved in appetite regulation through the two satiety hormones (ghrelin and leptin). Because low zinc levels result in digestive problems, metabolism is reduced to a great extent, leading to a loss of appetite followed by unintentional weight loss.
- ❖ thymus atrophy
- ❖ hypogonadism in males, impotence, reduced sperm counts
- ❖ mental lethargy
- ❖ eye and skin lesions
- ❖ night blindness
- ❖ taste abnormalities
- ❖ wounds that don't heal within 2-3 weeks
- ❖ an unexplained loss of smell and taste especially in older adults. Such a loss can lead to loss of appetite and pleasure in eating food which may cause malnutrition and other health problems.
- ❖ frequent brain fog as to thinking and memory problems. Zinc deficiency hinders energy production, muscle protein synthesis, and liver detoxification. This causes chronic fatigue, physical weakness, and brain fog (e.g. difficulty concentrating, remembering information, reduced attention, poor working memory). Zinc is important for neurotransmitter health such as dopamine, serotonin, and norepinephrine and thus a lack of zinc may contribute to mood changes like anxiety and depression. Research has shown that people who are depressed and anxious tend to have lower levels of zinc in their blood compared to healthy individuals. One meta-analysis found that depressed people tended to have "about 14% less zinc in their blood than most people do on average, and the deficiency was greater among those with more severe depression." ("Metals and mental health" Tori Rodriguez, [www.scientificAmerican.com/article/metals-and-mental-health/](http://www.scientificAmerican.com/article/metals-and-mental-health/), 9/1/2015)
- ❖ low insulin levels
- ❖ eczema-like rash. Zinc deficiency can be shown as acne, eczema, dry scaling skin, red pustules around the orifices and along the hands and feet, and seborrheic dermatitis (scaly patches on the scalp and other oily areas).
- ❖ acne (there is a strong correlation between low levels of zinc and the severity of acne)
- ❖ psoriasis
- ❖ other skin problems. Zinc plays an important role in the production of collagen, the structural protein that holds your skin together. Without enough zinc pregnant mothers and those who gain weight are more likely to develop stretch marks because the skin loses its elasticity. Oily skin is another issue that involves zinc as to having too many androgens (male hormones) which zinc helps regulate.
- ❖ histamine intolerance. Zinc inhibits the release of histamine which occurs in response to an allergen. A zinc deficiency causes more histamine to be released into tissues which then produces more symptoms associated with allergies (e.g. swelling itching, mucus, sneezing, and hives). High histamine levels increases a person's sensitivity to all allergic reactions called 'histamine intolerance.'
- ❖ increased risk of premature delivery and abortion in pregnancy

- ❖ harder to conceive. It is important in the menstrual cycle including ovulation. A zinc deficiency can negatively affect egg quality making it harder to become pregnant. Irregular periods can also result from low zinc.
- ❖ for infants poor growth may be the most sensitive sign of deficiency.
- ❖ women with infertility have lower zinc levels in the follicular fluids than fertile women. Zinc is needed including for ovulation and fertilization, along with implantation and development difficulties. Low zinc also affects male fertility in that it is associated with reduced sperm count, motility and abnormal sperm morphology (their form and structure).
- ❖ low libido in men and women (it is found in the ovaries and testes, and even marginally low levels of zinc can impact libido; low testosterone can be involved.)
- ❖ hearing loss and tinnitus. Research has found that many tinnitus patients are already deficient in zinc. And the lower the level of zinc the more severe the tinnitus can become.
- ❖ breast and prostate cancer. There is a gene called p53 which is said to protect against prostate and breast cancer. The gene requires zinc, and deficiencies of zinc can cause it to mutate which then dramatically increases the risk of both of these cancers.
- ❖ slower thinking
- ❖ low white and/or red blood cell counts, or low platelets. If this arises repetitively over different lab tests low zinc is something to consider and ask your doctor to run a zinc level.

#### Who is at risk:

The main causes of zinc deficiency are low intake, poor absorption, and medical conditions like heavy drinking of alcohol (which uses zinc to metabolize it), and diabetes/blood sugar imbalance which lead to urinary losses. Zinc is needed for the metabolism of glucose as well as to produce insulin. A meta-analysis found that supplementing with zinc can be beneficial in controlling blood sugar and lipids in type 2 diabetics. Zinc can also reduce insulin resistance and metabolic syndrome in kids who are obese. And low levels of zinc become more common when people are insulin resistant, prediabetic, or have type 2 diabetes. This can create a vicious cycle where zinc levels go down which then leads to further insulin resistance. Diabetics have decreased nutrient absorption including of zinc. Plus, high blood sugar increases the frequency of urination so more zinc is lost through that too. Eating sugar, junk food and grains can block your body's ability to absorb zinc. There has been some research that found that zinc supplementation can be helpful with gestational diabetes such as improving fasting blood glucose and improving insulin sensitivity.

Others at risk include those with sickle cell anemia, cancer, chronic diarrhea, Crohn's, liver and kidney disease. Treating underlying diseases like GI and sickle cell may improve zinc absorption and utilization. Medications like NSAID's, acid blockers, antibiotics, diuretics, and immune suppressants also can take a toll. High stress and toxin exposure are other common causes of zinc deficiency. A yeast overgrowth such as from candida can lead to zinc deficiency.

GMO foods such as those that are sprayed with Roundup (glyphosate) blocks the absorption of zinc.

A plant-based diet is linked to lower zinc levels because the body is more efficient in absorbing zinc from animal rather than plant sources. It has been said that the #1 factor that impacts zinc absorption is the amount of phytate in the diet, which is in plant foods like grains, nuts, seeds and legumes. Soaking, fermenting, and sprouting can help reduce phytates, and maybe on average doing so will get rid of half of the phytate or so. Other factors impacting zinc availability include oxalate-rich leafy greens and foods grown in zinc-deficient soil, along with processed foods, can all lead to deficiency too. Sweating too much (e.g. from being physically active) also depletes zinc.

A mild deficiency is more common in infants, adolescents, women in general, and those over age 65. Women who are using birth control pills, copper IUDs, and vegetarians and vegans (zinc from plants is not absorbed as well as from animal foods) are at risk of low zinc levels too.

One study (European Journal of Nutrition, "Micronutrient status and intake in omnivores, vegetarians and vegans in Switzerland" R Schüpbach et al, Feb. 2017) found that zinc deficiency was the nutrient deficiency most prevalent among vegans. Vegetarians can increase its absorption by soaking beans and seeds for several hours, and eating leavened grain (e.g. bread) more than unleavened (e.g. crackers) because leavening partially breaks down phytates allowing more absorption of zinc. Eating cereals which contain phytic acid can block absorption of the mineral too.

Other groups who are at risk of deficiency include those people with GI issues (e.g. ulcerative colitis, IBD, Crohn's, leaky gut), and those who have had bariatric surgery. Low levels of zinc alters the gut microbiota and leads to the development of GI diseases.

Men ejaculating multiple times a day can lose considerable zinc through the semen, being 1 mg per instance as an average. The average absorption of zinc from food is around a third but it varies with what is being eaten. This means that a man would need to eat an extra 3 mg from food to compensate for each ejaculation.

For women pregnancy and breastfeeding can be very significant. Across an entire pregnancy there may be a need for 100 mg of zinc, but it accelerates over the full term. It has been said that early on maybe just an extra  $\frac{1}{4}$  mg a day is needed and later on maybe an extra  $\frac{1}{2}$  or  $\frac{3}{4}$  mg/day is needed. Breastfeeding is a different story. Early on an average of 2.2 mg/day of zinc is being lost, and it decreases to 1 mg/day after about 9 months of breastfeeding. Again, given the absorption rate of about a third from food, there is a need to eat food with three times such an amount to get what is needed.

Body builders need about 20 mg of zinc to add a kilogram (2.2 lbs.) of muscle, for those who are into working out or doing more intense body building. And once more, attention has to be paid to the one-third absorption issue as to eating food that contains 60 mg to achieve this amount.



People with chronic liver or renal disease, or sickle cell anemia can be deficient. Consuming too much sugar especially if there is a copper deficiency can create zinc deficiency by promoting fatty liver disease.

Increased intake of calcium and phosphate can also reduce or block zinc absorption. It has been said that if a person is getting 900 mg of calcium a day overall and 18 mg of zinc, adding a supplement of 500-600 mg of calcium then zinc absorption will be cut in half, and another 8 mg of zinc will be needed to make up for it. But our bodies compensate somewhat and if our zinc status is low we can absorb more. A high fiber diet can also block zinc absorption. Vitamin B6 can increase zinc absorption.

Other potential groups who can become deficient include those with cancer and other chronic illnesses. Chronic diarrhea also can lead to excessive loss of zinc. The NHANES 3 study (National Health & Nutritional Exam Study) found that 35-40% of adults over age 60 had low zinc levels. Statin drugs reduced zinc levels by 8%.

There is a vicious cycle between thyroid hormone and zinc. You need zinc to produce the hormone, and you need the hormone to absorb zinc. Consequently, hypothyroidism can cause a zinc deficiency. There is also a vicious cycle between zinc and hydrochloric acid (HCl, stomach acid). HCl is needed to absorb zinc, and zinc is needed to make HCl. So low levels of the mineral can result.

One survey found that 44% of kids with sickle cell disease were zinc deficient, and 60-70% of adults with the condition are too. About 30-50% of alcoholics have low zinc levels because drinking alcohol decreases absorption and increases urinary zinc excretion. Plus, alcoholics may not have the best of diets which can also contribute to zinc deficiency. Alcoholism in a pregnant mother can lead to zinc deficiency in the fetus, which is called fetal alcohol syndrome (FAS). Characteristics of FAS include inadequate growth pre- and post-natal, small jaw, joint deformities, cleft palate, and heart and kidney abnormalities. Zinc deficiency during pregnancy also can result in a high rate of miscarriages, along with joined toes or fingers, and hydrocephalus ('water on the brain') in the baby.

Exercise increases the need for zinc to help with muscle use and repair after the fact, and so athletes are at risk of deficiency. Stress depletes zinc. Stress also leads to copper buildup in the tissues, and copper is antagonistic to zinc. Insufficient zinc allows more copper to increase, and excess copper is a stressor, further lowering zinc and creating a vicious cycle.

Zinc deficiency is related to various autoimmune diseases such as type 1 diabetes, rheumatoid arthritis, lupus, celiac disease, and Hashimoto's.

Breast milk provides sufficient zinc for the first 4-6 months of life but for babies 7-12 months old who need 3 mg/day it may not offer enough. Foods or formula that are used should contain zinc. Infants who have mild-to-moderate growth delays can improve with zinc supplementation if they are found to be deficient in the mineral.

Taking zinc with milk may also decrease its absorption. Some antibiotics can impair zinc absorption, and taking them 2 hours before or 4-6 hours after zinc can help minimize this effect. Conversely, zinc can impair the absorption of some antibiotics such as tetracycline, doxycycline, Cipro, and Noroxin, as well as penicillamine.

Ways to test for zinc deficiency include through blood plasma, urine, and hair analysis. A taste test is another means but it is not considered as reliable.

Vitamins and minerals that can be antagonistic to zinc include:

- ❖ cadmium (smaller levels of cadmium may be more toxic in zinc deficiency states and higher levels of cadmium can be tolerated with adequate zinc levels)
- ❖ lead
- ❖ mercury
- ❖ calcium
- ❖ chromium
- ❖ cobalt
- ❖ copper
- ❖ iron
- ❖ manganese
- ❖ nickel
- ❖ phosphorous
- ❖ selenium. However, selenium can also make zinc more bioavailable to the body, along with niacin (vitamin B3) doing this too, with both helping with the absorption of zinc.
- ❖ sodium
- ❖ vitamins B1, B10 (PABA), B12
- ❖ vitamin D
- ❖ vitamin E
- ❖ inositol

Mild zinc deficiency can be found in people using acid-blocking medications (e.g. Prilosec) and certain blood pressure drugs too. It can also occur with hypothyroidism.

Drugs that can adversely impact levels include:

#### Acid blockers

- ❖ Cimetidine/Tagamet
- ❖ Esomeprazole/Nexium
- ❖ Famotidine/Pepcid
- ❖ Lansoprazole/Prevacid
- ❖ Nizatidine/Axid
- ❖ Omeprazole/Prilosec
- ❖ Pantoprazole/Protonix
- ❖ Rabeprazole/Aciphex

- ❖ Ranitidine/Zantac

#### Antacids

- ❖ Aluminum & magnesium hydroxide/Maalox, Mylanta
- ❖ Aluminum carbonate gel/Basaljel
- ❖ Aluminum hydroxide/Amphojel, AlternaGEL
- ❖ Calcium carbonate/Tums, Rolaids
- ❖ Magnesium hydroxide/Milk of Magnesia
- ❖ Sodium bicarbonate/Alka-Seltzer, baking soda

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#### Antituberculosis

- ❖ Ethambutol/Myambutol
- ❖ Isoniazid/INH
- ❖ Rifampin/Rifadin

#### Antiviral

- ❖ Delavirdine/Rescriptor
- ❖ Etravirine/Intelence
- ❖ Foscarnet/Foscavir
- ❖ Lamivudine/Epivir
- ❖ Nevirapine/Viramune
- ❖ Zidovudine, AZT/Retrovir
- ❖ Zidovudine and Lamivudine/Combivir

#### Blood pressure

- ❖ Clonidine/Catapres
- ❖ Hydralazine/Apresoline
- ❖ Methyldopa/Aldomet
- ❖ Moexipril/Univasc

#### ACE Inhibitors:

- ❖ Benazepril/Lotensin
- ❖ Captopril/Capoten
- ❖ Enalapril/Vasotec
- ❖ Enalapril and HCTZ/Vasotec HCT
- ❖ Fosinopril/Monopril
- ❖ Lisinopril/Prinivil, Zestril
- ❖ Moexipril/Univasc
- ❖ Quinapril/Accupril
- ❖ Ramipril/Altace
- ❖ Trandolapril/Mavik

#### Angiotensin II receptor blockers:

- ❖ Candesartan and HCTZ/Atacand HCT

- ❖ Irbesartan and HCTZ/Diovan HCT
- ❖ Valsartan and HCTZ/Diovan HCT

#### Diuretics, loop:

- ❖ Bumetanide/Bumex
- ❖ Ethacrynic acid/Edecrin
- ❖ Furosemide/Lasix
- ❖ Torsemide/Demadex

#### Diuretics potassium sparing

- ❖ Amiloride/Midamor (this may increase levels)
- ❖ Tramterene HCTZ/Maxzide, Dyzide, Dyrenium

#### Diuretics sulfonamide:

- ❖ Indapamide/Lozol

#### Diuretics, thiazide (and any combination drug that contains HCTZ - hydrochlorothiazide):

- ❖ Chlorothiazide/Diuril
- ❖ Chlorthalidone/Hygroton
- ❖ HCTZ/Hydrodiuril
- ❖ Losartan and HCTZ/Hyzaar
- ❖ Methylchlorothiazide/Enduron
- ❖ Metolazone/Zaroxolyn

#### Chelating

- ❖ Pencillamine/Cuprimine

#### Cholesterol

- ❖ Cholestyramine/Questran
- ❖ Ezetimibe/Zetia

#### Fibrates

- ❖ Clofibrate/Atromid
- ❖ Fenofibrate/Tricor
- ❖ Gemfibrozil/Lopid

#### Corticosteroids:

- ❖ Betamethasone/Dirpolene, Luxiq
- ❖ Dexamethasone/Decadron
- ❖ Methylprednisolone/Medrol
- ❖ Prednisone/Deltasone, Sterapred, Liquid pred
- ❖ Triamcinolone/Aristocort cream

#### Inhaled corticosteroids:

- ❖ Budesonide/Rhinocort
- ❖ Flunisolide/Nasarel, Nasalide

- ❖ Fluticasone/Flonase

Hormone replacement therapy/oral contraceptives:

- ❖ Estradiol/Activella, Climara, Combipatch, Estrace, Estraderm, Estring, EstroGel, Femring, Menostar, and many others)
- ❖ Estradiol and testosterone/EstraTest, Depo-Testadiol
- ❖ Estrogen conjugated/Premphase, Prempro
- ❖ Estrogen-containing drugs (hormone replacement and birth control pills)
- ❖ Ethinyl estradiol (found in many birth control pills)
- ❖ Levonorgstrel (found in many birth control pills and Plan B)
- ❖ Norethindrone (found in many birth control pills)
- ❖ Vaginal inserts with estrogen

Nonsteroidal aromatase inhibitors for breast cancer:

- ❖ Anastrozole/Arimidex

Selective estrogen receptor modulators used for breast cancer:

- ❖ Raloxifene/Evista
- ❖ Tamoxifen/Nolvadex
- ❖ Toremifene/Fareston

Miscellaneous

- ❖ Calcium supplementation (in excess)
- ❖ Casein (protein from dairy)
- ❖ Chelation therapy to remove heavy metals
- ❖ Chocolate (because it's relatively high in copper)
- ❖ Coffee, tea, soda (caffeinated)
- ❖ Copper supplementation (in excess)
- ❖ Estrogen dominance
- ❖ Food dyes rich in copper
- ❖ Heavy metal toxicity (likely all heavy metals but these for sure)
  - cadmium (which occurs from smoking)
  - mercury (which occurs from certain seafood, environmental chemicals, amalgams)
  - arsenic
  - lead

Sources (avoid drinking caffeinated beverages for 15 minutes before or after because it may interfere with zinc absorption):

- ❖ adzuki beans (10 mg/ 1 cup)
- ❖ Alaska king crab (6.5 mg/3 oz)
- ❖ almonds (4.5 mg/1 cup)
- ❖ amaranth (2 mg/1 cup)

- ❖ apple cider vinegar (1 T dissolved in a glass of water before a meal, to help increase stomach acid and in the process better absorb minerals including zinc, magnesium, copper and other minerals)
- ❖ apricots (0.2 mg/100 g)
- ❖ asparagus
- ❖ avocado (0.6 mg/100 g)
- ❖ beef (7 mg/3 oz)
- ❖ beef liver (3.9 mg/100 g)
- ❖ black beans (7.1 mg/1 cup)
- ❖ blackberries (0.5 mg/100 g)
- ❖ blueberries (0.2 mg/100 g)
- ❖ Brazil nuts (2.7 mg/1 cup)
- ❖ broccoli (0.7 mg/1 cup)
- ❖ brown rice
- ❖ Brussel sprouts (0.5 mg/1 cup)
- ❖ buckwheat (4 mg/1 cup)
- ❖ cantaloupe (0.2 mg/100 g)
- ❖ cashews (3.8 mg/1 cup)
- ❖ cereals
- ❖ cheddar, mozzarella cheese
- ❖ chia seeds
- ❖ chicken (2.6 mg/100 g)
- ❖ chickpeas (2.5 mg/1 cup)
- ❖ chocolate (dark, 9.6 mg/100 g)
- ❖ crab
- ❖ dairy
- ❖ some denture creams (and use of 2 or more 2.4 oz. tubes/week may lead to toxic levels, and copper deficiency can occur within months if using more than is recommended)
- ❖ eggs
- ❖ flounder or sole
- ❖ hazelnuts (3.3 mg/1 cup)
- ❖ hemp seeds (3 mg/1 cup)
- ❖ kefir
- ❖ kidney beans (5.1 mg/1 cup)
- ❖ lake trout
- ❖ lamb chops (5.3 mg/100 g)
- ❖ lentils (2.5 mg/1 cup)
- ❖ lobster (2.5 mg/3 oz. steamed)
- ❖ meat
- ❖ mung beans (5.5 mg/1 cup)
- ❖ mushrooms (1.4 mg/1 cup cooked)
- ❖ navy beans (7.6 mg/1 cup)
- ❖ nutritional yeast
- ❖ nuts

- ❖ oats (6.2 mg/1 cup)
- ❖ oysters (40 mg/3 oz although others say there are 149 mg in 100 g, about 3.5 oz.)
- ❖ peanuts (2.4 mg/1 cup)
- ❖ peaches (0.2 mg/100 g)
- ❖ peas (1.8 mg/1 cup)
- ❖ pecans (2.25 mg/1 cup)
- ❖ pine nuts (8.7 mg/1 cup)
- ❖ pomegranate (0.4 mg/100 g)
- ❖ pork chops
- ❖ pumpkin seeds (10.1 mg/1 cup)
- ❖ quinoa (2 mg/1 cup)
- ❖ raspberries (0.4 mg/100 g)
- ❖ salmon
- ❖ sesame seeds (11.2 mg/1 cup)
- ❖ soybeans (2.5 mg/1 cup)
- ❖ spinach (1.8 mg/1 cup)
- ❖ sunflower seeds (3.5 mg/1 cup)
- ❖ Swiss chard (1.7 mg/1 cup)
- ❖ tofu (1.8 mg/4 oz.)
- ❖ turkey
- ❖ walnuts (3.6 mg/1 cup)
- ❖ wheat germ (14 mg/3 oz)
- ❖ whole grains
- ❖ wild rice (2.2 mg/1 cup cooked)
- ❖ yogurt

#### Recommended amounts:

The dosage people need can vary based on factors like height and weight, but 8-11 mg/day are recommended by NIH. The average American adult gets 9-13 mg/day, and research suggests that 8% fall short of the requirement. However, other research has found that less than half of older adults in the U.S. consume adequate zinc because of lower absorption efficiency that arises with age. The need for zinc is estimated to be 50% higher for those following a plant-based diet because there is less of it available in plant food because phytate which is a chemical found in whole grains, legumes, nuts and seeds can prevent the absorption of some minerals including zinc. Eating foods in the garlic and onion (allium) family increases bioavailability of zinc from grains and legumes by up to 50%. Iron supplements (above 25 mg/day) and calcium may also interfere with zinc absorption. Taking iron supplements between meals helps decrease the impact on zinc absorption. Taking it with fiber also inhibits its absorption.

Where zinc levels should be in the blood as to 'normal' or 'optimal' is not fully agreed upon. The range is somewhere around 70-100 mcg/dl for optimal, and acceptable levels are around 44-115. Some suggest that the higher point of 100 may be the sweet spot. Serum and plasma blood levels may not be identical. (In two studies serum levels were greater when taken from the same person.) Others say that measuring zinc in the blood serum is not advised at all because it is too

variable such as based on what was eating in the last meal. Instead it should be through lymphocyte proliferation analysis (meaning looking at what actually gets inside the cell).

Zinc can also be helpful in detoxing from arsenic, mercury and cadmium, and so if one has elevated levels of those heavy metals more zinc may be needed.

Zinc and copper need to be kept in the proper ratio as well. For most people a ratio of 15-20:1 between zinc/copper can be used. Others recommend a ratio around 10:1 or 8:1. For older individuals the ratio may be up to 40:1. Some recommend taking a zinc supplement an hour before a meal where phytates are present to allow greater absorption. It should also not be taken at the same time as a calcium supplement or a calcium-rich meal but a good separation should be had between them.

The upper limit of safety for zinc is 40 mg/day and if you get it through food it is unlikely you will be up that high. Taking a supplement can put you at greater risk of having too much in your system. It is advised not to take more than 40 mg/day for a week. Zinc lozenges should be limited to no more than a week as well. Zinc taken in high doses – more than 40 mg/day for an extended period of time can cause problems such as:

- ❖ dizziness
- ❖ headaches
- ❖ drowsiness
- ❖ increased sweating
- ❖ loss of muscle coordination
- ❖ alcohol intolerance
- ❖ hallucinations
- ❖ anemia
- ❖ vomiting
- ❖ copper deficiency is the biggest problem if higher doses of zinc are taken for too long

However, there are some nutritionists and doctors who recommend 30-40 mg/day and say that it only becomes a problem when one takes more than 100 mg/day.

Zinc is absorbed more efficiently in smaller amounts. Symptoms of excess zinc can include diarrhea, vomiting, stomach cramps, and headache. If zinc-containing nasal sprays are used too long it can result in the loss of sense of smell.

Long term use of zinc over 100 mg/day has been associated with a decrease in good cholesterol (HDL), reduced immune function, and increased risk of prostate cancer although there is also research that zinc may suppress prostate cancer. Use of a zinc oxide sunscreen is unlikely to significantly increase zinc levels or cause toxicity.



Use of zinc in a nasal gel has been linked to temporary or permanent loss of smell. Other symptoms of zinc toxicity include nausea, vomiting, abdominal cramps, loss of appetite, and diarrhea.

If you are looking for a supplement to provide just the daily recommended amount use of a multi-vitamin may be a better choice.

Industrial workers such as those who galvanize metal (using zinc) can get too much of it in the process. GI distress, vomiting, nausea, and dizziness can result from very acute toxicity.

Zinc comes in different forms (e.g. zinc: sulfate, acetate, gluconate, citrate, picolinate, bis-glycinate, and methionine to name some). The gluconate, acetate, citrate and sulfate forms performed similar to each other. Zinc oxide is not absorbed as well. One small study found that the bis-glycinate version increased the availability of zinc by 43% compared to the gluconate form. Another small study found that the methionine version increased blood levels 30% more than the same amount of the sulfate version. The body tends to absorb more when levels are low, and less when the zinc levels are high.

You also have to pay attention to how much of a zinc compound (sulfate, acetate, etc.) is zinc and how much is the other stuff. There is what is called 'elemental' zinc meaning 'just zinc.' So if some zinc compound says it is 50 mg and half of it is the other stuff, then you are ingesting 25 mg of elemental zinc. However, if it says something like Zinc (as picolinate) 50 mg, that means you are getting 50 mg of elemental zinc.

	<b>Elemental Zinc (approximately)</b>
Zinc acetate	36%
Zinc citrate	11%
Zinc gluconate	14%
Zinc monomethionine	31%
Zinc picolinate	21%
Zinc Sulfate	
anhydrous	41%
heptahydrate	23%
monohydrate	36%

The WHO recommends using acetate, sulfate or gluconate forms because they have been the most well studied as to fixing zinc deficiencies especially in kids with diarrhea. Zinc citrate is pretty good too. Some 'experts' say picolinate is very good, and others do not like it. The sulfate forms are not recommended as much by some. Zinc, vitamin A, magnesium and vitamin B6 used together are said to be synergistic. Together they are said to support cardiovascular health, bones, muscles, nerves, the immune and reproductive systems, healthy skin, and wound healing.

Yet another opinion (these coming from Healthline.com) offer the following:

- ❖ zinc gluconate is one of the most common OTC forms, is less expensive, and is often used in cold lozenges and nasal sprays
- ❖ zinc acetate is also used in cold lozenges
- ❖ zinc sulfate is said to help prevent deficiency of the mineral, and has been shown to reduce the severity of acne
- ❖ zinc picolinate may be better absorbed than other forms
- ❖ zinc orotate is one of the most common forms
- ❖ zinc citrate is as well absorbed as the gluconate version but has a less bitter taste

Use of folic acid at the rate of 400 mcg every other day for a month was shown to reduce zinc excretion by 50%. Copper, magnesium, calcium, iron, and nickel in larger amounts reduce zinc absorption.

Zinc can interfere with some lab tests. A consultation with a doctor is also advised if you are taking any drugs, have an infection, diabetes or heartburn. The most accurate way to measure zinc levels is through a neutrophil zinc level, or through a hair analysis. A blood test is not accurate, because little is in plasma and instead it is inside of cells. A simple, at-home test that gives you a rough idea is to buy a bottle of zinc sulfate (one such brand is Premier Research Labs, Liquid Zinc Ultra that can be found on Amazon. Another brand that is recommended by some is Standard Process Zinc Test, also available on Amazon.) You take a capful of the liquid and put it in your mouth.

<b>Taste</b>	<b>Significance</b>
No metallic taste, 'tastes like water'	Zinc deficient
Delayed metallic taste (e.g. 10-15 seconds)	Some zinc deficiency
Slight metallic taste, intensifies over time	Zinc levels are adequate, but could be higher
Strong metallic taste	Likely to have optimal zinc levels

<b>Age</b>	<b>Female/male</b>	<b>Tolerable upper limit</b>
0-6 months	2 mg/2 mg	4 mg
7 months - 12 months	3 mg/3 mg	5 mg
1-3 years	3 mg/3 mg	7 mg
4-8 years	5 mg/5 mg	12 mg
9-13 years	8 mg/8 mg	23 mg
14-18 years	9 mg/11 mg	34 mg
19+ years	8 mg/11 mg	40 mg
Pregnant	12 mg	34 mg
Lactating	13 mg	34 mg

The NHANES 3 survey determined that about 45% of Americans do not obtain sufficient zinc, even if they consume zinc rich foods.

Some of the drugs that zinc sulfate can interact with (red indicates serious, blue moderate, black milder interactions) are shown below.

- ❖ **alendronate**: it may interfere with the drug's absorption and effectiveness. Zinc should be taken at least 30 minutes after taking a dose of the drug.
- ❖ **baloxavir**: it may interfere with the drug's absorption and effectiveness. Zinc should be taken at least 30 minutes after taking a dose of the drug.
- ❖ **carbonyl iron**: using these two together in infants may reduce efficacy in improving growth. It is not known if this is an issue with adults. Separating their administration times by 12 hours is advised.
- ❖ **cinoxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **ciprofloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **deferiprone**: it may interfere with absorption and effectiveness of the drug. Taking them at least 4 hours apart is advised.
- ❖ **delafloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **demeclocycline**: it may interfere with absorption and effectiveness of the drug. Separating their dosing by at least 3-4 hours is advised.
- ❖ **dolutegravir**: it may interfere with absorption and effectiveness of the drug. The drug should be taken at least 2 hours before or 6 hours after the zinc.
- ❖ **eltrombopag**: it may interfere with absorption and effectiveness of the drug. The drug should be taken on an empty stomach at least 2 hours before or 4 hours after the zinc.
- ❖ **elvitegravir**: it may interfere with absorption and effectiveness of the drug. The drug should be taken at least 2 hours before or 6 hours after the zinc.
- ❖ **enoxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **etidronate**: it may interfere with the absorption and effectiveness of the drug. Taking zinc at least 2 hours before or after the drug is advised.
- ❖ **ferrous fumarate/gluconate/sulfate**: using these two together in infants may reduce efficacy in improving growth. It is not known if this is an issue with adults. Separating their administration times by 12 hours is advised.
- ❖ **gatifloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **gemifloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.

- ❖ **grepafloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **heme iron polypeptide**: using these two together in infants may reduce efficacy in improving growth. It is not known if this is an issue with adults. Separating their administration times by 12 hours is advised.
- ❖ **ibandronate**: it may interfere with the drug's absorption and effectiveness. Zinc should be taken at least 30 minutes after taking a dose of the drug.
- ❖ **iron polysaccharide/iron protein succinylate**: using these two together in infants may reduce efficacy in improving growth. It is not known if this is an issue with adults. Separating their administration times by 12 hours is advised.
- ❖ **levofloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **lomefloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **minocycline**: it may interfere with absorption and effectiveness of the drug. Separating their dosing by at least 3-4 hours is advised.
- ❖ **moxifloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **nalidixic acid**: it may interfere with the absorption and effectiveness of the drug. Taking the drug 2 hours before or after the zinc is advised.
- ❖ **norfloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **ofloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **omadacycline**: it may interfere with absorption and effectiveness of the drug. Separating their dosing by at least 3-4 hours is advised.
- ❖ **oxytetracycline**: it may interfere with absorption and effectiveness of the drug. Separating their dosing by at least 3-4 hours is advised.
- ❖ **patiromer**: using these together may make both less effective. Taking them several hours apart is advised. Talk to your doctor for concerns.
- ❖ **pencillamine**: it may interfere with absorption and effectiveness of the drug. Taking the zinc at least 2 hours before or after the drug is advised.
- ❖ **raltegravir**: it may interfere with absorption and effectiveness of the drug. The drug should be taken at least 2 hours before or 6 hours after the zinc.
- ❖ **risedronate**: it may interfere with the drug's absorption and effectiveness. Zinc should be taken at least 30 minutes after taking a dose of the drug.

- ❖ **sarecycline**: it may interfere with absorption and effectiveness of the drug. Separating their dosing by at least 3-4 hours is advised.
- ❖ **sodium polystyrene sulfonate**: using these together may make both less effective. Taking them several hours apart is advised. Talk to your doctor for concerns.
- ❖ **sparfloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
- ❖ **tetracycline**: it may interfere with absorption and effectiveness of the drug. Separating their dosing by at least 3-4 hours is advised.
- ❖ **tiludronate**: it may interfere with absorption and effectiveness of the drug. Taking the zinc at least 2 hours before or after the drug is advised.
- ❖ **trientine**: using them together may reduce efficacy of one or both.
- ❖ **trovafloxacin**: it may interfere with absorption and effectiveness of the drug. Taking the drug 2-4 hours before or 6 hours after zinc may be advised.
  
- ❖ **Malabsorption syndrome**: absorption may be decreased in such patients, and so a larger dose may be required.
  
- ❖ **Renal dysfunction**: dosing may need to be adjusted, reduced, or zinc omitted in patients with renal problems.
  
- ❖ interactions with immunosuppressants (e.g. prednisone) may be antagonized by zinc, although clinical cases have not been reported, and so it is thought to be a minor issue.
- ❖ diuretics (thiazide, chlorthalidone, HCTZ) increase zinc excretion by as much as 60%, so prolonged use of the drug could deplete zinc levels.