HEAVY METALS & ESSENTIAL ELEMENTS:

Understanding Their Role in Your Health & Best Test Methods

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Where we live, our diet and supplementation routine, and our lifestyle choices all affect how much of the essential and toxic elements end up in our bodies. We can be exposed to toxic elements in the water we drink, in the soil or irrigation water used to grow the foods we eat, through environmental pollution of the air we breathe, and through smoking.

Iodine, selenium, copper, zinc, and magnesium are all essential elements that we need to obtain from our diets to keep us healthy, but too much can be harmful so it's important to check that they are in the right ranges. Lithium and bromine are not currently classified as essential elements but research has shown they are needed in small amounts, while high levels are toxic.

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Why Are Tests Done in Urine or Blood Spot?

In short, there is a right way and a wrong way to test elements. For example, very little lead is found in urine, but it is carried around the body by red blood cells where it forms a tight complex with hemoglobin. For this reason whole blood, and not serum or urine, is used to monitor exposure to lead.

Arsenic can only be found in blood very soon after exposure and then it is no longer detected, but any recent exposure in the past several days can be measured effectively in urine. Whole blood dried on filter paper is better than serum testing for zinc, copper, and magnesium, because it reflects intracellular levels and can reveal deficiencies earlier than a typical blood (serum/plasma) test.

Iodine is only tested in urine because this gives the best information about whether you have enough iodine in your daily diet. Mercury, cadmium, and selenium are tested in both urine and blood spot because each gives different information about your exposure to these elements – for example, blood spot cadmium tells you about recent exposure to cadmium, whereas urinary cadmium reflects whole body exposure over a long period of time; while for mercury and selenium, organic versions of these elements are found in blood while inorganic forms are found in urine.

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Heavy Metals & Essential Elements in ZRT Profiles

Essential Elements

Iodine

An essential component of the thyroid hormones T4 and T3, iodine is commonly found in dairy products, seafood, iodized salt, and grains. Iodine deficiency compromises thyroid hormone production and leads to serious diseases including irreversible cretinism, pregnancy complications, goiter, and decreased cognitive function. Iodine deficiency has also been associated with breast cancer.

Selenium

An essential dietary element, selenium is incorporated into the selenoproteins in the body, which include several important antioxidants. These selenoproteins play vital roles in thyroid hormone synthesis, free radical scavenging, DNA synthesis, and cancer prevention. Foods such as brazil nuts, seafood, eggs, and grains are significant selenium sources. Excess selenium intake can be toxic, while inadequate selenium affects thyroid function. Heavy metals form tight complexes with selenium and reduce its bioavailability.

Magnesium

An essential element required for cellular metabolism and protein synthesis, magnesium is important for strong bones and muscles, heart health, nerve function, and cellular energy production. Deficiency of magnesium results in muscle weakness or cramping, confusion, seizures, and even cardiac arrhythmias. Magnesium levels are affected by problems with kidney function and alcoholism, and some drugs such as diuretics and proton pump inhibitors can cause deficiency. It is estimated that up to 60% of people in the US do not get sufficient dietary magnesium and could be deficient; magnesium-rich foods include kelp, nuts, green vegetables, and whole grains.

Zinc

An essential dietary nutrient with an important role in the immune system, zinc is involved in multiple enzyme systems in the body. Like copper, zinc is transported bound to ceruloplasmin, but it also binds to hemoglobin. Zinc deficiency compromises the immune system, wound healing, and the senses of taste and smell. Excessive zinc intake above the RDA of 15 mg/day can cause copper deficiency, impaired immune function, and adverse effects on the LDL/HDL cholesterol ratio. Disturbances in zinc and copper metabolism, including a low zinc/copper ratio, low zinc levels, or high copper levels, have been implicated in autism spectrum disorders. Good sources of dietary zinc include red meat, poultry, beans, nuts, seafood (especially oysters), whole grains, and dairy products.

Copper

An essential element that is required as a cofactor in multiple enzyme systems, copper is transported in the bloodstream bound to the protein ceruloplasmin, which delivers copper safely to target tissues without causing damage. Copper is necessary for normal development of connective tissue, nerve sheaths, and bone, and is also a participant in energy metabolism. Deficiency can result in neurological dysfunction and connective tissue abnormalities, while excess copper can cause liver dysfunction. Too much dietary zinc can cause copper deficiency. Good sources of dietary copper include liver, oysters, nuts, seeds, dark chocolate, and whole grains.

Bromine

Bromine is a common component of flame proofing agents, fumigants, medications,

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food products, and pool/spa sanitizers. High environmental exposure can lead to excess accumulation. If iodine status is low, bromine can interfere with thyroid hormone synthesis.

Lithium

Historically used to treat mood disorders, lithium is now known to play a positive role in overall health. In particular, it restores nerve function and improves brain health. When lithium levels in the water supply are too low, increased suicide rates have been found in studies.

Heavy Metals

Arsenic

Arsenic is an environmental heavy metal found in some foods such as fish, shellfish, seaweed, rice, and fruit. It has multiple toxic effects in the body and also competes with selenium, preventing its incorporation into the selenoproteins. This therefore has the same effects as selenium deficiency on thyroid hormone production.

Mercury

Mercury is a highly toxic heavy metal that can build up in body tissues including the brain. Most of our exposure to mercury is through dental amalgams, seafoods, and vaccinations. Mercury toxicity can cause nervous system damage. Mercury and selenium have a very high affinity for each other and form a tight complex; as a result, mercury causes similar problems to selenium deficiency or arsenic exposure.

Cadmium

Cadmium is rated the 4th most toxic heavy metal after arsenic, lead, and mercury on the priority list of hazardous substances issued by the CDC. Smoking is a major source of human cadmium exposure; smokers have about twice the body burden of cadmium compared to non-smokers. In non-smokers, the primary source of exposure is in food.

Lead

Lead is a toxic heavy metal implicated in severe neurological defects in developing children. Exposure of the general population to high levels of environmental lead occurred largely as a result of its use as an additive in gasoline and paint. Lead is still found in older plumbing systems and paint, and in soil that was contaminated before its use was banned. Lead exposure is particularly dangerous in children, in whom it can negatively affect brain development and intelligence.

Gadolinium

Gadolinium is used in contrast media for MRI tests. While it's normally rapidly eliminated in the urine, people with kidney problems can retain it in the body where it has harmful effects and can even accumulate in the brain. Levels of gadolinium in urine can reflect exposure from a recent MRI, or from cumulative exposure with multiple MRIs done years ago; bone loss in patients developing osteoporosis may release gadolinium stored in the bones into the circulation and raise urine levels. Testing for gadolinium exposure should be carried out at least 48 hours after an MRI, when it would normally have been eliminated from the body.

Thallium

Sources of thallium exposure are fruits and vegetables grown near coal fired power plants, cement factories, and smelting operations. Urine thallium levels are the best indicator of recent exposure. Thallium is believed to be more toxic than mercury, cadmium, and lead.

Uranium

Uranium can be found in well water and waste from the nuclear industry. Root vegetables like potatoes, turnips, parsnips, and sweet potatoes contribute a significant amount of uranium in the diet and are linked to the amount of uranium in soil. Uranium's toxicity comes from its similarities to calcium, which it can replace in bone.

Creatinine

Creatinine is a metabolic by-product that is excreted at a relatively constant rate as long as kidney function is not impaired. It is measured to correct dried urinary element levels for hydration status; the greater the fluid intake, the lower the creatinine level. Iodine, bromine, selenium, arsenic, mercury, and cadmium results are therefore expressed in μg/g creatinine to allow for urine dilution.