

Order: 999999-9999



Test: X999999-9999-1

Client #: 999999

Doctor: Sample Doctor, MD

Doctors Data Inc

123 Main St.

St. Charles, 60174 USA

Patient: Sample Patient

Id: 999999

Age: 8 **DOB:** 01/01/2018

Sex: Male

Sample Type: Head

Hair Color: Black

Sample Size: 0.097 g

Sample Collection

Date Collected

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10/01/2026

10/09/2026

10/16/2026

Analyte		Result	Unit	Percentile		Reference Interval
				68 th	95 th	
Arsenic*	(As)	1.2	µg/g			< 0.05
Lead*	(Pb)	2.5	µg/g			< 0.3
Mercury*	(Hg)	0.02	µg/g			< 0.3
Cadmium*	(Cd)	0.098	µg/g			< 0.03
Thallium*	(Tl)	0.0010	µg/g			< 0.0006
Thorium*	(Th)	0.0025	µg/g			< 0.001
Antimony*	(Sb)	0.037	µg/g			< 0.066
Beryllium*	(Be)	0.0007	µg/g			< 0.0006
Barium*	(Ba)	1.6	µg/g			< 0.75
Uranium*	(U)	0.52	µg/g			< 0.03
Bismuth*	(Bi)	0.005	µg/g			< 0.04
Palladium*	(Pd)	0.0011	µg/g			< 0.001
Platinum*	(Pt)	<0.0002	µg/g			< 0.0005
Tungsten*	(W)	0.007	µg/g			< 0.003
Cesium*	(Cs)	0.0032	µg/g			< 0.001
Gold*	(Au)	0.012	µg/g			≤ 0.01
Gadolinium*	(Gd)	0.0019	µg/g			< 0.001
Tellurium*	(Te)	<0.015	µg/g			< 0.015
Aluminum*	(Al)	10	µg/g			< 8
Nickel*	(Ni)	0.15	µg/g			< 0.2
Silver*	(Ag)	0.31	µg/g			< 0.14
Tin*	(Sn)	0.65	µg/g			< 0.2
Titanium*	(Ti)	0.58	µg/g			< 0.3
Zn/Cd	(Ratio)	949				≥ 1000
Ca/Pb	(Ratio)	185				≥ 150
Se/Hg	(Ratio)	33				≥ 0.3
Total Toxic Representation						

Notes:

*This test was developed and its performance characteristics determined by Doctor's Data Laboratories in a manner consistent with CLIA requirements. The U. S. Food and Drug Administration (FDA) has not approved or cleared this test; however, FDA clearance is not currently required for clinical use. The results are not intended to be used as a sole means for clinical diagnosis or patient management decisions.

Methodology: ICP-MS

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Analyte		Result	Unit	Percentile					Reference Interval
				2.5 th	16 th	Mean	84 th	97.5 th	
Calcium*	(Ca)	462	µg/g						160 – 500
Magnesium*	(Mg)	30	µg/g						12 – 50
Sodium*	(Na)	190	µg/g						15 – 100
Potassium*	(K)	250	µg/g						3 – 50
Copper*	(Cu)	9.7	µg/g						11 – 40
Zinc*	(Zn)	93	µg/g						110 – 190
Manganese*	(Mn)	2.7	µg/g						0.08 – 0.50
Chromium*	(Cr)	0.11	µg/g						0.05 – 0.3
Vanadium*	(V)	0.083	µg/g						0.002 – 0.10
Molybdenum*	(Mo)	0.096	µg/g						0.03 – 0.07
Boron*	(B)	3.2	µg/g						0.40 – 2.5
Iodine*	(I)	0.21	µg/g						0.25 – 1.3
Lithium*	(Li)	0.012	µg/g						0.003 – 0.020
Phosphorus*	(P)	141	µg/g						100 – 140
Selenium*	(Se)	0.66	µg/g						0.4 – 0.7
Strontium*	(Sr)	3.0	µg/g						0.21 – 3
Sulfur*	(S)	47300	µg/g						44000 – 51000
Cobalt*	(Co)	0.039	µg/g						0.004 – 0.02
Iron*	(Fe)	28	µg/g						7 – 16
Rubidium*	(Rb)	0.38	µg/g						0.006 – 0.08
Ca/Mg	(Ratio)	15.4							7 – 20
Ca/P	(Ratio)	3.28							1.5 – 6
Na/K	(Ratio)	0.76							0.5 – 2.5
Zn/Cu	(Ratio)	9.6							3.4 – 19

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INTRODUCTION

Hair is an excretory tissue for essential, nonessential, and potentially toxic elements since elements are irreversibly incorporated into growing hair. Therefore, hair element analysis provides an indirect screening test for exposure, physiological excess, deficiency, or maldistribution of elements in the body. Clinical research indicates that hair levels of specific elements, particularly toxic elements such as cadmium, mercury, lead, and arsenic are highly correlated with pathological disorders. For such elements, levels in hair provide a longer temporal window of exposure than levels in blood or urine.

Hair provides a noninvasive estimation of ongoing/recent exposure to elements but cannot provide a definitive estimate of the extent of long-term net retention or body burden, nor toxic effects. All screening tests have limitations that must be taken into account. The correlation between hair element levels and physiological disorders is influenced by numerous factors. Individual variability and compensatory mechanisms are major factors that affect the relationship between the distribution of elements in hair and symptoms or pathological conditions.

It is also very important to keep in mind that scalp hair is vulnerable to external contamination by exposure to hair treatments and products. Likewise, some hair treatments (e.g., permanent solutions, dyes, bleach) can strip hair of endogenously acquired elements and result in falsely low values. Careful consideration of these limitations must be made when interpreting hair analysis results. The data provided should be evaluated in conjunction with symptomatology, diet analysis, occupation and lifestyle, physical examination, and other analytical laboratory tests.

Caution: The contents of this report are not intended to be diagnostic, and the physician using this information is cautioned against treatment based solely on the results of this screening test. For example, copper supplementation based on a result of low hair copper is contraindicated in patients with Wilson's Disease.

Toxic Metals

↑ Arsenic High

Hair Arsenic (As) is an excellent marker to assess chronic exposure to inorganic As. Inorganic As is highly toxic, whereas organic As is largely harmless and rapidly excreted. Inorganic As accumulates in hair, nails, skin, thyroid gland, bone and the gastrointestinal tract. Organic As, such as arsenobetaine found in shellfish, is rapidly excreted in the urine and as such is not primarily represented in hair.

Arsenic has been included in certain historical lice treatment formulations. As can cause malaise, muscle weakness, vomiting, diarrhea, dermatitis, and skin cancer. Long-term exposure may affect the peripheral nervous, cardiovascular, and hematopoietic systems. As is a major biological antagonist to selenium.

Common sources of As found in hair include drinking water (well), dietary sources (including rice), insecticides (calcium and lead arsenate), smog, industrial exposure, particularly in the manufacture of electronic components (gallium arsenide) and shellfish (arsenobetaine). Rice and rice products are the most significant dietary source of inorganic As worldwide, with brown rice containing higher levels than white rice due to retention in the bran layer. Rice-based foods such as cereals, milk, flour, snacks, and syrups can all contain measurable inorganic As, particularly when grown in regions with high-As groundwater such as Bangladesh, India, parts of China, and the U.S. South-Central states. Infant rice cereals and snacks are of special concern, prompting FDA guidance levels of ≤ 100 ppb inorganic As.

Other dietary sources include fruit juices, sweeteners like organic brown rice syrup, and certain cereal grains, though wheat, barley, oats, and corn generally contain much lower levels. Vegetables grown in contaminated soil, such as carrots, beets, spinach, lettuce, and potatoes, may accumulate As, and hijiki seaweed is a known outlier with extremely high inorganic As content. Please note that hair can be contaminated externally with As from water. Health agencies recommend varying grains, rinsing rice before cooking, using excess water to reduce As content, limiting hijiki consumption, and testing private wells for As.

Confirmatory tests for acute, recent exposure to As are whole blood or urine.

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Toxic Metals

↑ Lead Extremely High

This individual's hair Lead (Pb) level is considered to be extremely elevated and is consistent with significant prolonged exposure to Pb. Hair is an excellent indicator of exposure to Pb. However, elevated levels of Pb in head hair can be an artifact of hair darkening agents, or dyes, e.g., lead acetate. Although these agents can cause exogenous contamination, transdermal absorption can contribute to body burden.

Pb has neurotoxic and nephrotoxic effects and interferes with heme biosynthesis. Pb may also affect the body's ability to utilize the essential elements calcium, magnesium, and zinc. At high levels of body burden, Pb may have adverse effects on memory and cognitive abilities, nerve conduction, and metabolism of vitamin D. Impaired erythropoiesis and anemia may be present. Children with hair Pb levels above 3 µg/g have been reported to have more learning problems than those with less than 3 µg/g.

(Arch. Environ. Hlth. 51: 214-220, 1996).

Symptoms associated with excess Pb are vague, but include: loss of appetite and body weight, poor memory, fatigue, constipation, headaches, inability to concentrate, and decreased coordination.

Sources of exposure to Pb include: welding, old leaded paint (dust/chips), drinking water, some fertilizers, industrial waste, lead-glazed pottery, manufacture of stained glass, Ayurvedic herbs and use of firearms.

Confirmatory tests for Pb include urine and whole blood.

↑ Cadmium high

Hair Cadmium (Cd) levels provide an excellent indication of exposure to Cd. Cd is a toxic heavy metal that has no metabolic function in the body. Moderately high Cd levels, about 4-8 µg/g, may be associated with hypertension, while very severe Cd toxicity may cause hypotension. Cd adversely affects the kidneys, lungs, testes, arterial walls, and bones and interferes with many enzymatic reactions. Chronic Cd excess can lead to microcytic, hypochromic anemia and proteinuria with loss of beta-2-microglobulin, and functional zinc deficiency. Cd excess is also commonly associated with fatigue, weight loss, osteomalacia, and lumbar pain.

Cd absorption is reduced by zinc, calcium, and selenium. Cd is found in varying amounts in foods, from .04 µg/g for some fruits to 3-5 µg/g in some oysters and anchovies. The use of tobacco products significantly increases Cd intake. Refined carbohydrates have very little zinc in relation to the Cd. West coast oysters are notoriously high in Cd.

If hair zinc is not abnormal, external contamination may have caused the elevated hair Cd level. Exogenous contamination may come from permanent solutions, dyes, bleach, and some hair spray. Confirmatory tests for Cd are whole blood or urine.

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Toxic Metals

↑ Thallium

Thallium (Tl) is a highly toxic element which, like lead and mercury, accumulates in many body tissues. Hair levels reflect exposure to Tl. Common sources of Tl are: foods (marine organisms concentrate Tl up to 700 times), rodenticides/pesticides tobacco, contaminated water, electronics components, fly ash, cement dust, and some fertilizers. Tl is rapidly and completely absorbed when ingested, inhaled or brought into contact with skin. Spinacia and Brassica group vegetables, such as kale, cabbage, spinach and lettuce, efficiently assimilate Tl from soil. Alarming, this has made dark green leafy vegetables one of the most common sources of Tl exposure. Observations are suggestive that Spinacia and Brassica group vegetables may be contaminated with Tl, and high consumption of brassica vegetables may be clinically problematic. Tl has been detected in prenatal vitamins, and clinicians should be aware that the neurotoxic metal readily crosses the placenta to the developing fetus (Schwalfenberg, et al. Heavy metal contamination of prenatal vitamins. Toxicology Reports. March 2018. DOI: 10.1016/j.toxrep.2018.02.015). Symptoms of Tl excess include: sleep disturbances, cardiac, optical, dermatological, liver, GI, and kidney dysfunctions. Albuminuria and alopecia are consistent with Tl excess. Potassium, selenium, and sulfhydryl compounds (e.g. glutathione) diminish Tl retention and toxicity. Tl toxicity can have a long latency period before clinical symptoms become apparent.

↑ Thorium High

Correlations among the levels of Thorium (Th) in hair and other tissues have yet to be established.

Th is a radioactive element with 13 known isotopes; Th-232 constitutes 99% of the naturally- occurring Th. Th-232 is the isotope measured at Doctor's Data and reported for this sample. Th-232 has a half-life of 1.4[Exp. 10] years. It decays by alpha-emission to produce radium-228 (Ra-228). In turn, Ra- 228 (half-life 6.7 years) decays to other radioactive isotopes and eventually converts to lead. This radioactive decay process produces alpha, beta, and gamma emissions.

Th is considered mildly toxic for two reasons, the low-level radioactivity and slight biochemical toxicity. Th salts at high levels may inhibit amylase and phosphatase enzymes. Most orally ingested thorium, if not excreted in urine, binds to bone tissue where it has a long biological half-life (years).

Th has about the same abundance in the earth as does lead and is encountered in mining for titanium and rare earth elements. Commercially, Th is used in incandescent gas lantern mantles, refractory materials, and as a coating for tungsten in electronic applications. Th may also be present in tungsten-inert-gas (TIG) welding electrodes.

A urine elements analysis can be performed to assess further the extent of Th exposure.

↑ Beryllium High

Beryllium (Be) has been found in the hair, but documentation correlating exposure, tissue levels and hair levels is lacking. Therefore, Be is measured in hair primarily for investigational purposes. Be can be toxic to humans and animals. Be is a biological antagonist of magnesium. Be has a long-term effect of inducing abnormal activity in T lymphocytes, causing immune dysregulation and hypersensitivity reactions. In animals, Be has been shown to induce rickets and to damage the liver, kidney, lungs, and skin. Be is poorly absorbed in the gastrointestinal tract but is readily absorbed by the skin and lungs. Inhalation is the primary route of exposure to Be and chronic uptake results in dyspnea, cough and pulmonary distress. (Am. Rev. Respir. Dis.; 173:464-473, 1988).

Possible sources of Be are: electronic components, metal alloys used in aircraft and aerospace applications (especially aluminum-copper-beryllium alloys), bearing sleeves, optical lens coatings, and some phosphors in fluorescent lights. Tobacco contains Be, and smoking immediately increases the Be levels in the blood and urine.

A confirming test for Be exposure is urine elements analysis. Be is slowly excreted in urine and may be found elevated many months after the exposure.

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Toxic Metals

↑ Uranium High

The levels of Uranium (U) in hair usually reflect levels of U in other tissues. However, hair may be externally contaminated by shampoos or hair products that contain U. U is a nonessential element that is very abundant in rock, particularly granite, lignite, monazite sands, and phosphate rocks. U is present at widely varying levels in drinking water, root vegetables, and present in high phosphate fertilizers. High levels of U detected may be due to water sourced from a rock shale, which can indicate the potential for radon gas release, as U naturally decays into radon, a radioactive gas that can migrate through soil and accumulate indoors. A radon test for the home may be considered to assess potential exposure risk. Other sources of U include: ceramics, some colored glass, many household products and tailings from U mines. Spent U rods have been milled into armor piercing bullets and missile heads. Uranyl cations bind tenaciously to protein, phosphate, nucleotides, and bone, where it substitutes for Ca. Published data are sparse, but there appears to be a correlation between U exposure, nephrotoxicity and cancer. Kidney and bone are the primary sites of U accumulation. All isotopes of U are radioactive; ²³⁸U is the most abundant and lowest energy emitter. It is important to note that the measured result, which is ²³⁸U, does NOT necessarily indicate or imply exposure to highly enriched ²³⁵U, which is used in nuclear power and weaponry. Chronic fatigue is often reported in association with hair U levels >0.5 µg/g (Doctor's Data observations). U is rapidly cleared from blood and deposited in tissues. Currently, DTPA is the only effective chelating agent for ACUTE U poisoning. However, it must be administered immediately and is not effective once U has transferred from blood to tissues. Currently there are no available chelators or complexing agents that have been established to be effective for ameliorating U retention associated with long-term, low-level exposure to U. Urine or fecal elements analysis can be performed to confirm recent or ongoing exposure to U. Because U is such a potent nephrotoxin, one might test for urinary wasting of amino acids and low molecular weight proteins (B-2-microglobulin) in patients with markedly elevated hair U levels.

↑ Palladium

The relationship between the levels of palladium (Pd) in hair and exposure to the metal has yet to be determined. Pd compounds are rarely encountered by most people. Most palladium compounds should be regarded as toxic and carcinogenic. There have been numerous reports of allergic contact dermatitis to Pd. The main contact sources are jewelry and dental materials (gold alloys). The characteristics of Pd (ductile, malleable, resistant to corrosion, easily fused and welded) make it an acceptable material for jewelry making and dentistry. Palladium is used in the field of communications in facing electrical contacts in automatic switch gear. The nonmagnetic springs in clocks and watches as well as special coatings for mirrors are also made of Pd. The chemicals industry uses Pd as a catalyst. Palladium is often found associated with platinum in Australia, Brazil, Russia, Ethiopia, and North and South America, as well as with nickel and copper deposits in Canada and South Africa.

↑ Cesium

Cesium (Cs) is a naturally-occurring element found in rocks, soil, and dust at low concentrations. It is present in the environment only in the stable form of ¹³³Cs; the radioactive isotopes ¹³⁴Cs and ¹³⁷Cs are not measured or reported by Doctor's Data. Natural deposits of Cs ores occur in Maine, South Dakota and Manitoba (Bernic Lake), Canada. Cesium may bio-accumulate in aquatic food chains.

Cesium may be used in high-density drilling fluids (oil and gas industry) and may contaminate local water and vegetation. Cesium may occur naturally in mineral waters; one study analyzed the Cs concentration in 163 mineral and thermal waters and found the level ranged from 4.5 to 148 µg per liter. Cs has been found in cow milk.

Cesium can be absorbed after oral ingestion, upon breathing contaminated air and through contact with the skin. Cesium is readily absorbed across the brush border of the intestines in a manner similar to potassium, and most is eventually excreted through the urine and feces. The biological half-life of Cs in humans ranges from 15 days in infants to 100–150 days in adults.

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Toxic Metals

The cesium-137 isotope is used in cancer treatments, for ventricular function and pulmonary imaging studies, industrial radiology, and for food and instrument sterilization; Cs137 agents may contain amounts of Cs133. Again, it is emphasized that Cs measured at Doctor's Data is Cs133, not Cs137.

↑ Tin High

Hair Tin (Sn) levels have been found to correlate with environmental exposure. Depending on the chemical form, Sn can be a potentially toxic element. Inorganic Sn has a low degree of toxicity, while organic Sn has appreciable toxicity. The main source of Sn is food. Other possible sources are: dental amalgams, cosmetics, preservatives, food and beverage containers, pewter, bronze, and anticorrosive plating. Sn exposure correlates with canned food consumption, with concentrations depending on whether cans are lacquered. Symptoms of excess Sn include: skin, eye, and GI tract irritation, muscle weakness, anemia, and testicular degeneration.

Confirmatory tests for recent Sn exposure are whole blood or urine.

Essential Elements

↑ Sodium High

Sodium (Na) is an essential element with extracellular electrolyte functions. However, these functions do not occur in hair. Hair Na measurement should be considered a screening test only; blood testing for Na and electrolyte levels is much more diagnostic and indicative of status. High hair Na may have no clinical significance, or it may be the result of an electrolyte imbalance. A possible imbalance for which high hair Na is a consistent finding is adrenocortical hyperactivity. In this condition, blood Na is elevated while potassium is low. Potassium is elevated (wasted) in the urine. Observations at Doctor's Data indicate that Na and potassium levels in hair are commonly high in association with elevated levels of potentially toxic elements. The elevated Na and potassium levels are frequently concomitant with low levels of calcium and magnesium in hair. This apparent phenomenon requires further investigation.

Appropriate tests for Na status as an electrolyte are measurements of Na in whole blood and urine, and measurements of adrenocortical function.

↑ Potassium High

High hair Potassium (K) is not necessarily reflective of dietary intake or nutrient status. However, elevated K may be reflective of metabolic disorders associated with exposure to potentially toxic elements.

K is an electrolyte and a potentiator of enzyme functions, but neither of these functions take place in hair. Elevated K in hair may reflect overall retention of K by the body or maldistribution of this element. In adrenocortical insufficiency, K is increased in blood, while it is decreased in urine; cellular K may or may not be increased. Also, hair is occasionally contaminated with K from some shampoos. Observations at Doctor's Data indicate that K and sodium levels in hair are commonly high in association with toxic element burden. The elevated K and sodium levels are often concomitant with low levels of calcium and magnesium in hair. This apparent phenomenon requires further investigation.

Elevated hair potassium should be viewed as a screening test. Appropriate tests for excess body K include measurements of packed red blood cell K; serum or whole blood K and sodium/K ratio, measurement of urine K and sodium/K ratio; and an assessment of adrenocortical function.

↓ Copper Low

Hair Copper (Cu) levels are usually indicative of body status with two exceptions: (1) addition of exogenous Cu (occasionally found in hair preparations or algacides in swimming pools/hot tubs), and (2) low hair Cu in Wilson's or Menkes' diseases. In Wilson's disease, Cu transport is defective and Cu accumulates, sometimes to toxic levels, in intestinal mucosa, liver and kidneys. At the same time, it is low in hair and deficient in other peripheral tissues. In Menkes' disease, the activity of Cu-dependent enzymes is very low. Cu supplementation is contraindicated in these diseases.

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Essential Elements

Cu is an essential element that is required for the activity of certain enzymes. Erythrocyte superoxide dismutase (SOD) is a Cu (and zinc) dependent enzyme; lysyl oxidase (LOX) which catalyzes crosslinking of collagen is another Cu dependent enzyme. Adrenal catecholamine synthesis is Cu dependent, because the enzyme dopamine beta-hydroxylase, which catalyzes formation of norepinephrine from dopamine, requires Cu.

Symptoms of Cu deficiency include: elevated cholesterol, increased inflammatory responses, anemia, bone and collagen disorders, reproductive failure, and impaired immunity. Possible reasons for a Cu deficiency include: intestinal malabsorption, insufficient dietary intake, molybdenum excess, zinc excess, and chelation therapy. Cu status is adversely affected by excess of antagonistic metals such as mercury, lead, cadmium, and manganese.

Confirmatory tests for Cu deficiency are serum ceruloplasmin to rule out Wilson's disease (ceruloplasmin is deficient in Wilson's disease), a whole blood or packed red blood cell elements analysis, and a functional test for Cu (barring zinc deficiency) is measurement of erythrocytes SOD activity. Erythrocyte SOD activity is subnormal with Cu deficiency.

↓ Zinc Low

A result of low hair Zinc (Zn) may be indicative of low Zn in whole blood, red blood cells, and other tissues. Hair analysis is a good screen for Zn deficiency provided that the hair sample has not been chemically treated (permanent solutions, dyes, and bleaches); such hair treatments can significantly lower the level of Zn in hair. Other laboratory tests to confirm Zn status are whole blood or packed red blood cell elements analysis.

Zn is an essential element that is required in numerous biochemical processes including protein, nucleic acid, and energy metabolism. Zn is an obligatory co-factor for numerous enzymes including alcohol dehydrogenase, carbonic anhydrase, and superoxide dismutase.

Zn competes for absorption with copper and iron. Cadmium, lead and mercury are potent Zn antagonists. Zn deficiency can be caused by malabsorption, chelating agents, poor diet, excessive use of alcohol or diuretics, metabolic disorder of metallothionein metabolism, surgery, and burns. Hair levels of Zn (copper and selenium) were decreased in human subjects after switching from a mixed to a lactovegetarian diet. (Am. J. Clin. Nutr.; 55:885-90,1992).

Hair Zn is commonly low in diabetics, and in association with ADD/ADHD and autism (Doctor's Data observation). Reported symptoms of Zn deficiency include: fatigue, apathy, hypochlorhydria, decreased vision and dysgeusia, anorexia, anemia, dermatitis, weak/brittle nails and hair, white spots on nails, alopecia, impaired wound healing, sexual dysfunction (males), and hypogonadism.

↑ Manganese High

Hair manganese (Mn) levels generally reflect actual body stores, but external contamination can influence hair Mn. Since particulate manganese-containing dust is the most common source of Mn toxicity, hair is considered to be an excellent tissue for the assessment of Mn exposure. However, high hair Mn can be an artifact of contamination from hair treatments/products or well water (containing high Mn). These possibilities should definitely be considered and ruled out before proceeding with therapies to alleviate an apparent excess of Mn.

Mn is an essential element which is involved in the activation of many important enzymes. However, Mn excess is postulated to result in glutathionyl radical formation, reduction of the free glutathione pool, and increased exposure of adrenal catecholamines (e.g. dopamine) to free radical damage. Excess Mn causes degeneration of myelin pigmented dopaminergic neurons which results in abnormally low levels of serotonin and dopamine in the brain. This is hypothesized to be a reason behind the neurotoxic effects attributed to Mn overload.

The brain is particularly affected by Mn excess. Symptoms or conditions consistent with excessive Mn include: lethargy, disorientation, memory loss, anxiety, emotional instability, and bipolar-like behaviors (laughing and crying), aberrant or violent behaviors, and tremor or Parkinson-like symptoms.

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Essential Elements

Occupationally, the greatest sources of exposure to Mn dust and fumes occur in mining of the element, and in the production and fabrication of iron and steel. In addition, various Mn compounds are widely used in fertilizers, animal feeds, pharmaceutical products, dyes, paint dryers, catalysts, wood preservatives, and ceramic production. Mn is also an air pollutant derived from the gasoline additive MMT.

Other sources of exposure include contaminated teas, contaminated drinking water, some street drugs, and smoking. Conditions predisposing to Mn excess are: iron or calcium deficiency, chronic infection, and impaired liver function. Mn excess is occasionally associated with alcoholism (hepatic dysfunction), and biliary cirrhosis/obstruction.

A confirmatory test for Mn excess is Whole Blood Elements.

↑ Boron High

Boron (B) is normally found in hair but the correlations among B absorption, and tissue and hair levels of B have yet to be determined. B has a low order of toxicity, but excessive intake induces riboflavinuria. Exogenous contamination of hair with B is possible since B is present in some soaps. B is also present in some cleaners, cement, ceramics, and glass.

↑ Rubidium High

Hair Rubidium (Rb) levels may correlate with exposure and with Rb levels in other tissues. Rb is chemically very similar to potassium and competes with potassium in some enzymatic reactions; substitution for potassium by Rb may or may not result in inhibition. (Comp. Biochem. Physiol.; 73: 223, 1982, Haematologica 75: 27, 1990). Rubidium is not considered to have a biological function; due to its chemical similarity to potassium, it may be taken up by plants and animals.

The low toxicity of Rb is illustrated by the fact that no symptoms of toxicity were observed in nine men in which 10 - 15% of their total body potassium was replaced by Rb (Horm. Metab. Res., 13:175,1980). Earlier studies with rats demonstrated that on a potassium-deficient diet, death occurred when 50% of muscle tissue was replaced with rubidium (Follis AJP 1943 Jan; Vol. 138 no. 246-250). Rb82 is used in medical tests such as positron emission tomography (PET) scans, myocardial perfusion scans, and brain scans. Rb may have antidepressant activity, particularly in patients with kidney disease (Canavese, Blood Purif 2008;26:311-314). Although Rb toxicity is exceedingly rare, excessive Rb intake may result in inhibition of I uptake by the thyroid gland and interfere with cardiac muscle contraction. It is considered moderately toxic at high levels of ingestion and may result in symptoms of failure to gain weight, ataxia, hyper irritation, skin ulcers, and anxiety or nervousness. Rubidium exposure may exacerbate pre-existing heart conditions, kidney conditions, or potassium imbalance.

Rb is used in electron tubes, light-sensitive cathodes, and other electrical equipment. The metal is used in the manufacture of photocells and in the removal of residual gases from vacuum tubes. Rubidium salts are used in glasses and ceramics and in fireworks. Plants, such as sugar beets, may use rubidium in potassium-deficient soils. Soybeans, beef, tomatoes, and ground coffee are food sources containing relatively high levels of Rb (~ 90 - 200 ppm). Daily intake varies from 1-5 mg depending on geography and diet.

Total Toxic Element Indication

The potentially toxic elements vary considerably with respect to their relative toxicities. The accumulation of more than one of the most toxic elements may have synergistic adverse effects, even if the level of each individual element is not strikingly high. Therefore, we present a total toxic element "score" which is estimated using a weighted average based upon relative toxicity using information from ATSDR (Agency for Toxic Substances and Disease Registry). For example, the combined presence of lead and mercury will give a higher total score than that of the combination of silver and beryllium.