Test Results

ZRT LABORATORY
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Beaverton, OR 97008
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2016 05 06 004 B

Samples Arrived: 05/06/2016
Date Closed: 05/06/2016

Samples Collected: Blood Spot: 05/01/16 00:00

Ordering Provider:

Jane Doe ND
8605 SW Creekside Pl
Beaverton, OR 97008

Ellen Elements
123 N Fake St
Aloha, OR 97007

Menses Status: Postmenopausal
Gender: Female

Last Menses: Unspecified
DOB: 2/22/1960 (56 yrs)

Patient Ph#: 555 555 5555

Height: Unspecified
Weight: Unspecified
Waist: Unspecified

Test Name	Result		Units	Range
Zinc (Blood Spot)	5.25	L	mg/L	6.35-9.35
Copper (Blood Spot)	1.01		mg/L	0.79-1.14
Ratio: Zn/Cu (Blood Spot)	5.2	L		6.6-10.2
Magnesium (Blood Spot)	43		mg/L	36-57
Selenium (Blood Spot)	150	L	µg/L	170-318
Cadmium (Blood Spot)	1.52	H	µg/L	<1.03
Lead (Blood Spot)	1.23		µg/dL	<2.50
Mercury (Blood Spot)	8.29	H	µg/L	<5.37

<dL = Less than the detectable limit of the lab.
N/A = Not applicable; 1 or more values used in this calculation is less than the detectable limit.

Therapies

None

David T. Zava, Ph.D.
(Laboratory Director)

Alison McAllister, ND
(Ordering Provider unless otherwise specified on pg1)

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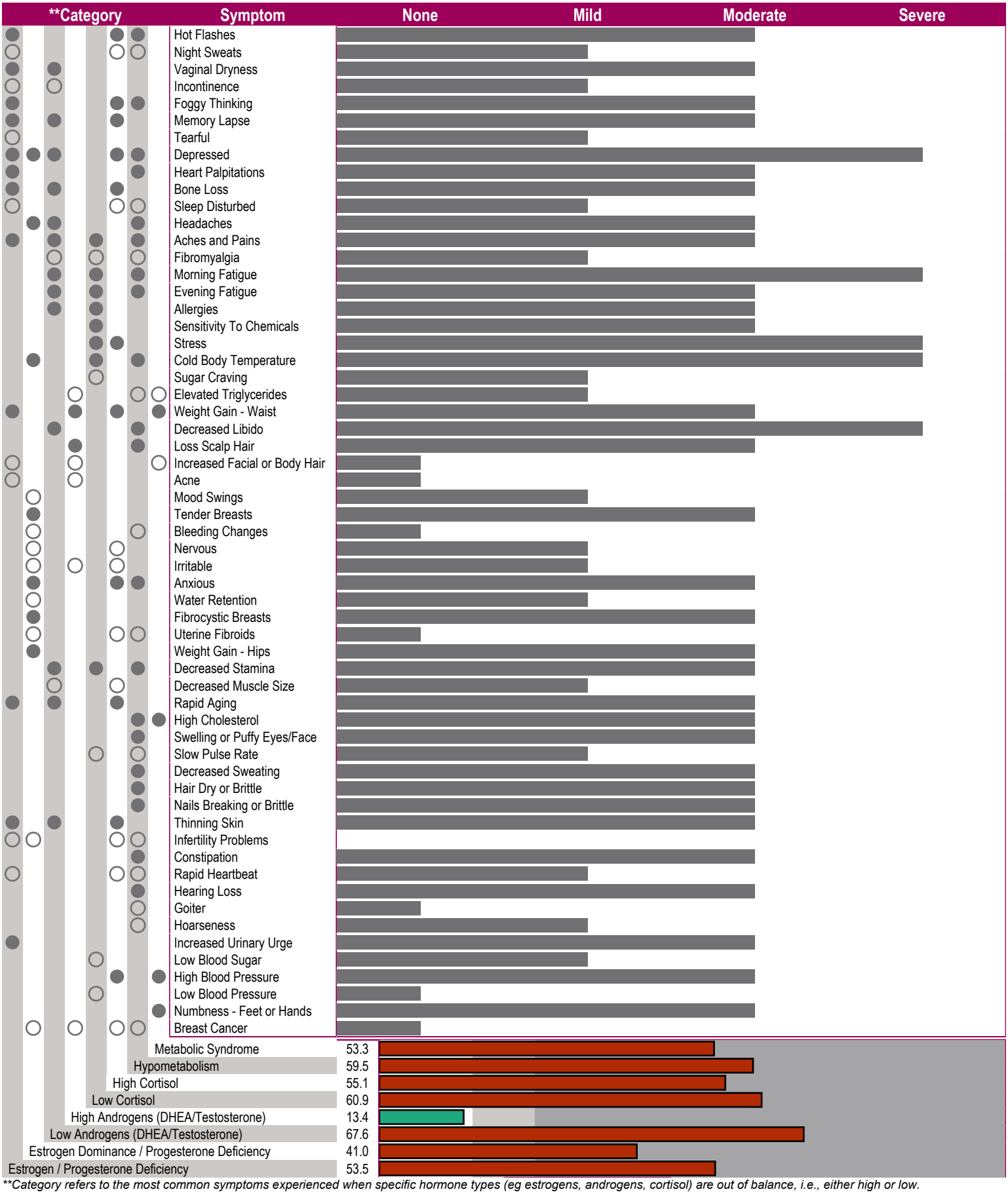
Composed by: 1165466421 at 5/6/2016 10:11:23 AM



***Category refers to the most common symptoms experienced when specific hormone types (eg estrogens, androgens, cortisol) are out of balance, i.e., either high or low.*

The above results and comments are for informational purposes only and are not to be construed as medical advice. Please consult your healthcare practitioner for diagnosis and treatment.

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Lab Comments

ZINC

Whole blood zinc is lower than the normal reference range.

Signs of zinc deficiency can include impaired cognitive function, behavioral problems, learning disabilities, infertility, impaired memory, decreased wound healing, loss of appetite, smell and taste failure, anemia, heart problems, excess copper retention, and a multitude of other impairments. There is a high prevalence of mild zinc deficiency in the elderly, increasing their susceptibility to infectious diseases. The frequency of zinc deficiency worldwide is estimated at around 20%.

Zinc is an essential element that is a co-factor in over 300 enzymes, and is required for cell growth and division, DNA synthesis, wound healing, taste, immune and thyroid function, blood clotting, reproduction, tissue growth, prevention of oxidative damage, and many other catalytic, structural and regulatory functions. Proper zinc nutrition has been shown to reduce the absorption of lead and prevent kidney damage caused by cadmium. Generally zinc absorption is greater when animal protein intake (e.g., eggs, beef, cheese) is high because released amino acids help to keep zinc in solution allowing optimal absorption. Phytates (present primarily in legumes and whole grains) chelate zinc and inhibit its absorption. Vegetarians and vegans, who consume high levels of plant-based phytates are more likely to be zinc deficient and often require more supplemental zinc in their diet. Alcohol consumption can also prevent zinc absorption due to reduced uptake and increased urinary excretion.

The current recommended dietary allowance (RDA) for zinc is 8 mg/day for women and 11 mg/day for men, while requirements are lower for children and higher during lactation or pregnancy. Zinc should always be well balanced with copper (see below). The primary sources of dietary zinc are red meat and poultry, with other good sources being oysters, beans, nuts, seafood, whole grains, fortified cereals, and dairy products.

For more information, you can find a review of zinc and the zinc/copper balance at:
http://www.omicsonline.org/copper-and-zinc-biological-role-and-significance-of-copper-zincimbalance-2161-0495.S3-001.pdf

COPPER

Whole blood copper is within the normal reference range.

Copper is an essential element required for antioxidant defense, immune function, neuron formation, iron metabolism, and as a cofactor of critical enzymes and proteins. The body contains around 100 mg copper, with the highest concentrations in the brain and liver. Copper absorption occurs primarily in the small intestine and stomach where a high pH causes copper to break apart from dietary macromolecules. In the bloodstream copper is transported by albumin and transcuperin to the liver where it binds to the copper binding protein ceruloplasmin. Adrenal hormones promote ceruloplasmin production, so liver and adrenal gland dysfunction can cause copper to accumulate in tissues and organs. Typically copper homeostasis is well maintained and toxicity is prevented via biliary excretion.

The current recommended dietary allowance (RDA) for copper is 0.9 mg/day for both men and women, although an argument has been made for a higher intake of 2.3 mg/day. Common sources of dietary copper include animal products, legumes, grains, and vegetables. Copper water pipes, cookware, drinking water, birth control, fungicides, and dietary supplements are all potential sources of copper exposure. Drinking water contributes about 6-13% of the average daily intake of Copper. Most diets contain enough copper (1-5 mg) to prevent a deficiency.

For more information, you can find a review of copper and the zinc/copper balance at:
http://www.omicsonline.org/copper-and-zinc-biological-role-and-significance-of-copper-zincimbalance-2161-0495.S3-001.pdf

ZINC/COPPER RATIO

Whole blood zinc/copper ratio is lower than the reference range.

An elevated level of copper, relative to zinc (low zinc/copper ratio), has been associated with a multitude of medical conditions including cardiovascular disease, fatigue, hypertension, autism, schizophrenia, muscle and joint pain, headaches, hyperactivity, insomnia, premenstrual syndrome, and depression. Very high tissue levels of copper are seen in patients with Wilson's disease. When zinc is low and copper elevated relative to zinc (low ratio), zinc intake via dietary supplementation should be considered at levels below the tolerable upper intake level (UL) of 40 mg zinc/day.

Zinc and copper are essential elements that together are symbiotic and antagonistic and crucial for normal neurological function, heavy metal detoxification, and cognitive development. Numerous brain and prion diseases including Parkinson's and

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Alzheimer's have shown abnormalities in zinc to copper ratio. When zinc and protein intake is adequate, copper excess is properly excreted through bile. On the other hand, if zinc and protein intake is low, along with reduced fats that promote bile production, copper is more likely to accumulate in tissue. Both zinc and copper are essential for the synthesis of metalloproteins, which are vital for metal metabolism, protection, and storage. The antioxidant zinc copper superoxide dismutase (CuZnSOD) utilizes copper and zinc in its active site to remove an electron from highly reactive and toxic superoxide molecules, forming less reactive oxygen species and hydrogen peroxide. The ratio of zinc to copper, not the quantity of zinc and copper, determine optimal functioning of superoxide dismutase.

For more information, you can find a review of the zinc/copper balance at:
http://www.omicsonline.org/copper-and-zinc-biological-role-and-significance-of-copper-zincimbalance-2161-0495.S3-001.pdf

MAGNESIUM

Whole blood magnesium is within the normal reference range.

Magnesium is an essential element and co-factor in approximately 600 enzyme systems. It is required for protein synthesis, reproduction, DNA and RNA synthesis, cellular energy production and storage, muscle and nerve function, blood glucose control, blood pressure regulation, along with many other vital bodily functions. Significant evidence shows that magnesium intake is inversely associated with the risk of stroke. The human body contains between 21-28 g of magnesium; approximately 53% is in bone, 27% in muscle, 19% in soft tissues, 0.5% in erythrocytes, and 0.3% in serum. After oral intake, around 40-50% of dietary magnesium is absorbed in the small intestine. It is estimated that 60% of Americans do not consume the daily recommended amount of magnesium, with the elderly the most vulnerable population due to decreased gut absorption and renal excretion. Magnesium homeostasis is primarily controlled by the kidney, aiding in prevention of deficiency or toxicity.

The current recommended dietary allowance (RDA) for magnesium is 420 mg/day for men and 320 mg/day for women in adults. Magnesium content of soil has decreased 20-30% over the last 60 years, and it is estimated that 80-90% of magnesium is lost during food processing of whole grains. Foods highest in magnesium are whole grains, nuts, legumes, potatoes, and dark leafy vegetable.

For online reviews on magnesium please see:
https://ods.od.nih.gov/factsheets/Magnesium-HealthProfessional/
http://advances.nutrition.org/content/4/3/378S.long
http://physrev.physiology.org/content/95/1/1.long

SELENIUM

Whole blood selenium is lower than the reference range. Whole blood selenium levels represent long-term exposure while urine selenium levels reflect recent intake.

Selenium is an essential element that has an important role in thyroid hormone metabolism, antioxidant function, and redox status. Selenium replaces sulfur in amino acids cysteine and methionine to form selenocysteine- and selenomethionine-containing proteins. Selenium supplementation has been shown to increase the effectiveness of cancer therapy or help prevent certain types of cancer such as lung, colon, bladder, and prostate. Low selenium is closely associated with thyroid diseases such as Hashimoto's thyroiditis, which is linked to lower levels of the selenium-containing enzyme glutathione peroxidase that protects against free radical production during normal thyroid hormone formation with activated iodine. Selenium supplementation above the recommended guidelines has been show to significantly decrease anti-TPO antibodies in Hashimoto disease patients.

Selenium in an essential part of at least 24 selenoproteins; the most widely studied are glutathione peroxidases, thioredoxin reductases, and iodothyronine deiodinases. Glutathione peroxidases (GPx) protect against free radicals and oxidative stress caused by heavy metals and oxidized lipids, thioredoxin reductases (TRx) are essential for cell development and proliferation, and iodothyronine deiodinases (ID) are essential for converting inactive thyroxine (T4) to triiodothyronine (T3) in all tissues throughout the body.

Selenium serves as a detoxifying agent, preventing tissue damage, by forming tight ionic complexes with heavy metals such as mercury, arsenic, lead, and cadmium. The selenium-heavy metal complex neutralizes heavy metals preventing them from creating reactive oxygen species (ROS) that damage tissues. If heavy metal exposure is high, it is essential that selenium intake is high enough maintain adequate levels of selenium-containing anti-oxidant enzymes and neutralizing complexes.

When selenium is low, as seen in this individual, consider consuming foods that contain higher levels of selenium, or selenium supplementation. A selenium intake of 40 µg/day is recommended as the minimal intake to prevent selenium deficiency. The current recommended dietary allowance (RDA) for selenium is 55 ug/day, which is believe to be the amount that fulfills the dietary need for known selenoproteins. Somewhat higher levels of selenium intake may be necessary if regional foods are grown in

selenium-deficient soils, or levels of heavy metals are high. Selenium supplementation above 400 ug/day can be toxic in some individuals. Food is the major source of selenium intake; however, the food content of selenium depends on the soil content of this mineral, which varies in different regions and is dependent on soil and water concentrations. Foods that are rich in selenium are shellfish, organ meat, dairy products, eggs, garlic, nuts (Brazil nuts very high), broccoli, fish, onion, ginseng, grains, and mushrooms.

For more information, you can find a review of selenium at: http://www.nature.com/ejcn/journal/v58/n3/full/1601800a.html

CADMIUM

Whole blood cadmium is higher than the normal reference range. Consider means to identify the source (e.g. tobacco products, contaminated food, industrial exposure) to prevent further cadmium exposure.
Cadmium is a non-essential toxic element and a nephrotoxin, estrogen mimic, and a group 1 carcinogen according to the International Agency for Research on Cancer. High levels of cadmium are believed to play a role in the development of lung, prostate, breast, endometrial, testicular, kidney, bladder, pancreatic and gall bladder cancer. Cadmium will accumulate in the renal cortex and cause tubular damage, preventing re-absorption of nutritional elements. Oxidative stress caused by cadmium can cause irregular gene expression, DNA damage, and cell death. Unlike mercury, cadmium does not readily cross the blood brain barrier, so neurotoxic effects are more common in the peripheral than the central nervous system. Cadmium bioaccumulates in the body, meaning that at birth levels are low, but by age 30 the body burden may reach toxic levels that adversely affect health. Blood cadmium levels are more representative of recent exposure, while urine cadmium levels represent long term exposure and kidney burden. The half-life of cadmium in the kidneys is 15-30 years making urine an ideal body fluid to assess lifetime exposure to cadmium.

Interactions of essential elements with cadmium play a large role in preventing cadmium toxicity. Zinc has been shown to reduce cadmium absorption, compete with cadmium for enzyme binding sites, and induce synthesis of metallothionein, a metal binding protein synthesized in the liver and kidneys that has a high affinity for heavy metals such as cadmium. Proper iron intake is important because competes with and lowers cadmium absorption in the intestines. Also, selenium can directly bind to cadmium, creating biologically inactive selenium-cadmium complexes, which helps lower cadmium burden, but also lowers the bioavailable levels of selenium necessary for antioxidant enzymes. High fiber will inhibit cadmiums absorption due to insoluble phytate-cadmium complexes formed in the intestine.

The major sources of cadmium exposure are from vegetables, grains, and tobacco, all which take up and accumulate cadmium from the soil. In the absence of heavy environmental exposure diet usually contributes to most of the cadmium exposure in non-smokers. Vegans and vegetarians are particularly susceptible to cadmium because of their high consumption of cadmium-containing plant foods and increased likelihood of zinc or iron deficiency. Absorption of dietary cadmium in the intestines is relatively low, with only 3-5% being absorbed from a normal daily intake of 8-25 µg/day. In comparison, lung absorption can be up to 50%, which is why cadmium in the urine of smokers is double that of non-smokers. Cadmium content in cigarettes from different countries varies by up to 10-fold depending on the content of cadmium in the soil where the tobacco is grown. Other sources of cadmium include seafood, organ meats, and root crops. Human activities and products such as mining, smelting, artisan glass manufacturing, waste disposal, fertilizer, pesticides, nickel-cadmium batteries, and vehicle exhaust all contribute to environmental and occupational cadmium exposure.

For more information, you can find a review of cadmium at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3686085/

LEAD

Whole blood lead is within the normal reference range.

Lead is a non-essential toxic element that can affect all organs in the body, including the nervous, skeletal, urinary, cardiovascular, immune, gastrointestinal and reproductive systems. High lead levels have been linked to an increased risk of stroke and heart disease along with higher mortality rate. Documented as a probable human carcinogen, lead has been associated with cancers of the brain, kidney, stomach, lung, and meninges. Leads toxic action is a result of its ability to mimic and replace other essential elements such as calcium, zinc, copper, magnesium, sodium, and iron. Lead also binds to sulfhydryl groups found in the catalytic site of many enzymes, inactivating them. The brain is the most sensitive organ to lead exposure due to damage to neurons and interference with neurotransmitters, specifically glutamate which is required for development and learning.

The Center for Disease Control (CDC) considers blood lead to be elevated at 10 µg/dl for adults and 5 µg/dl for children. Once lead is ingested (10% absorption) or inhaled (50% absorption) it is bound to hemoglobin in red blood cells and transported and deposited in different organs throughout the body. Children and pregnant women absorb around 50% of ingested lead, making them more susceptible to lead toxicity. Leads half-life in blood is around 40 days, which is about the same as the half-life of a red blood cell. Approximately 95% of lead that is absorbed will be stored in the bones with a half-life of around 25 years. Even after the exposure has ceased, lead can be re-introduced into the bloodstream from bone, meaning that blood levels indicate both

current and past exposure. As women enter menopause bone resorption increases, which can increase lead exposure to other organs.

Over the past three centuries environmental levels of lead have increased 1000 fold as a result of human activities. The prime contributors to this increase are leaded gasoline (banned 1996), lead paint (banned 1978) and lead-soldered copper pipes (banned 1986), mining operations, and other industrial applications. About one in three housing units in the United States has lead based paint hazards. The amount of lead in soil and dust in cities is proportional to the historical traffic flow volumes when lead was used in gasoline. Other uses of lead include ammunition, paints, ceramics, artisan glassware, hair dye, and cosmetics. In the United States occupational exposure is the main cause of lead poisoning in adults. About 15-20% of total lead exposure is attributed to lead released from old pipes used to deliver drinking water.

For more information, you can find a review of lead at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3485653/pdf/ITX-5-047.pdf

MERCURY

Whole blood mercury is higher than the reference range.

Mercury is a potent toxin. Mercury is found in three basic forms in the body: elemental mercury (HgO), inorganic mercury (Hg2+), and organic mercury (MeHg). High mercury exposure can cause symptoms which include balance problems, hearing loss, speech issues, and damage to peripheral nerves (tingling sensation). If selenium and/or zinc levels are low in concert with high whole blood mercury, it is recommended that they be increased to protect against antioxidant functions. The half-life of mercury in the brain is estimated at 20 years. There mercury is bound strongly to sulfur and selenium groups. Metallothioneins are proteins rich in sulfur residues and upregulated by zinc intake. They preferentially bind heavy metals such as mercury and cadmium, preventing them from causing further damage. Natural sources of mercury are volcanoes, weathering of rock, oceans, soil, and burning vegetation. It is estimated that 50-75% of environmental mercury comes from human activity; with the largest sources of mercury being coal fired power plants, gold mines, and metal and cement production.

Elemental Mercury (Hg0)

There is very little absorption of elemental mercury in the GI tract, but nearly 80% is absorbed by the lungs as a vapor. Absorbed elemental mercury is oxidized to inorganic forms of mercury, but remains a vapor long enough in the blood for a significant amount to penetrate the blood-brain barrier. Sources of elemental mercury include lightbulbs, mines, industrial manufacturing, dental amalgams, and thermometer production. Dental amalgams, which are 50% mercury, gas off between 2-28 µg elemental mercury/day, of which 80% is absorbed. Elimination of elemental mercury, which is converted to inorganic mercury in the body, is through urine and feces.

Inorganic Mercury (Hg2+)

Inorganic mercury can reach most organs, but primarily accumulates in the kidneys where it does the most damage. Most pharmaceutical and agricultural uses of inorganic mercury have been discontinued, but mercury chloride is still used as a pesticide and disinfectant. Essentially all mercury in urine is inorganic, whereas that in whole blood, mostly found in red blood cell membranes, is organic (e.g. methylmercury).

Organic Mercury (Methylmercury)

Methylmercury is the most common and toxic form of mercury. It is nonpolar and accumulates in fatty tissues such as the plasma membranes of red blood cells and other fatty tissues like the brain. Methylmercury is purported to be 100 times more toxic than elemental or inorganic mercury. Atmospheric elemental and inorganic mercury is converted by microorganisms in water to organic mercury, which works its way up the food chain and bio accumulates. Fish at the top of the food chain (tuna, shark, swordfish) have the highest levels of mercury, with 95-97% present as organic mercury. Nearly all methylmercury consumed in foods such as fish is absorbed by the GI tract. Once in the blood a majority of methylmercury binds to sulfur or selenium groups, with up to 10% accumulating in the brain. Most of the toxic effects of methylmercury are on the central nervous system, although the immune system and kidneys are affected as well. About 95% of mercury in blood is methylmercury, with the majority residing in red blood cells. This makes whole blood an ideal matrix to evaluate methylmercury burden. The half-life of methylmercury in blood is about 50 days, so whole blood analysis represents recent and past exposure to mercury.

For more information, you can find a review of mercury at:
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3253456/
https://www3.epa.gov/ttn/atw/hlthef/mercury.html

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