



Elemental Analysis Hair

Patient: **Order Number:**
DOB: Completed: July 21, 2011
Sex: Received: July 15, 2011
MRN: Collected: July 06, 2011

Healthscope Functional Pathology
Referring Laboratory
1868 Dandenong Road
Clayton, Victoria 3168
Australia

Toxic Elements

Element	Reference Range	Reference Range in µg/g
Aluminum	7.8	<= 17.3
Antimony	0.030	<= 0.016
Arsenic	0.019	<= 0.080
Barium	3.22	<= 1.70
Bismuth	<dl	<= 0.178
Cadmium	0.058	<= 0.022
Gadolinium	0.0036	<= 0.0005
Lead	2.376	<= 0.700
Mercury	0.06	<= 1.32
Nickel	0.61	<= 0.55
Rhodium	0.0005	<= 0.0005
Rubidium	0.004	<= 0.040
Thallium	<dl	<= 0.0004
Tin	0.326	<= 0.149
Uranium	0.0084	<= 0.0057

Nutrient Elements

Element	Reference Range	Reference Range in µg/g
Calcium	732	192-1,588
Chromium	0.08	0.01-1.58
Cobalt	0.034	0.001-0.129
Copper	78	8-136
Iron	13.8	5.2-24.4
Magnesium	299	11-122
Manganese	1.90	0.04-1.93
Molybdenum	0.02	0.01-1.24
Phosphorous	126	104-206
Selenium	0.59	0.58-1.13
Sodium	<dl	14-426
Strontium	2.49	0.01-4.40
Sulfur	50,721	41,781-60,894
Vanadium	0.022	0.003-0.108
Zinc	225	119-245

Reference Range

Lithium	<dl	<= 0.302
Potassium	8	<= 174

Ratios

	Inside Range	Outside Range	Reference Range
Ca/Mg		2	5-29
Ca/P	6		1-9

Commentary

Lab Comments

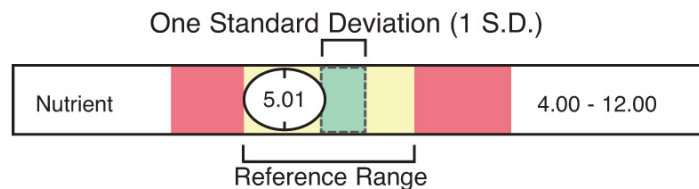
****Requisition/Sample labeling discrepancy noted. Ordering physician has been contacted and authorizes testing to be performed. 07/19/2011 EH**

This test has been developed and its performance characteristics determined by Genova Diagnostics, Inc. It has not been cleared or approved by the U.S. Food and Drug Administration.

Reference ranges are derived from a healthy adult population without hair treatments such as perms, dyes or bleach.

NOTE: Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Comments regarding clinical significance for the various elements are based on endogenous concentrations. Hair Analysis is always a reflection of both endogenous levels and external contamination (elements on the hair surface), thus is considered a screen rather than a definitive diagnostic assessment of body burden.

The **Reference Range** is a statistical interval representing 95% or 2 Standard Deviations (2 S.D.) of the reference population. One Standard Deviation (1 S.D.) is a statistical interval representing 68% of the reference range population. Values between 1 and 2 S.D. are not necessarily abnormal. Clinical correlation is suggested. (See example below)



NOTE: The following comments regarding clinical significance for the elements tested in this profile are based on *endogenous* concentrations. It should be noted that Hair Analysis is a reflection of both endogenous levels *and* external contamination (elements on the hair surface), thus is considered a screen rather than a definitive diagnostic assessment of tissue levels. Confirmation of toxicity may be accomplished via blood or urine testing. Provocative challenge urine testing (with the use of a chelating agent) can reflect tissue stores from previous exposure, whereas non-provoked urine or blood tests will reflect current exposure.

NOTE: Hair iron, phosphorus, sodium, and potassium are generally not thought to reflect dietary intake or body stores of these elements; however, abnormal hair levels may be associated with certain drugs and clinical conditions. Elevated hair iron may be found in smokers, x-ray technicians and individuals with certain forms of cancer. Notably low or high hair phosphorus is consistent with abnormal calcium and/or magnesium metabolism. Hair phosphorus also is typically elevated with kidney dialysis, and may be depressed in chronic hepatitis. Regular swimming in pools can elevate hair sodium. Although hair levels of sodium and potassium may be clinically significant in the presence of cystic fibrosis, celiac disease, and hyperparathyroidism, hair levels do not generally reflect tissue concentrations of these elements.

Antimony (Sb) is above the reference range. Hair Sb reflects past or chronic skin exposure, inhalation or ingestion of this element. Sb is a nonessential element considered to be more toxic than arsenic. Antimony's deposition in body tissues and its detrimental effects depend upon the oxidation state of the element. Sb+3 affects liver functions, impairs

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enzymes, and may interfere with sulfur chemistry. If Sb impairs phosphofructokinase (PFK), then purine metabolism may be disrupted, resulting in elevated blood and/or urine levels of hypoxanthine, uric acid and possibly ammonia. Sb+5 deposits in bone, kidney, and in organs of the endocrine system. "Antimony spots" may result from skin contact with Sb salts and vapors. Symptoms can be variable, including fatigue, myopathy, hypotension, angina and immune dysregulation.

Barium (Ba) is above the reference range. Hair Ba may be used for monitoring the accumulated body burden. Insoluble Ba compounds are not absorbed from the GI tract, and Ba salts such as Ba sulfate are commonly administered for diagnostic purposes such as x-ray procedures. Soluble Ba salts (chloride, carbonate, nitrate, sulfide) are absorbed when ingested and can have detrimental effects. Biochemically, Ba displaces or antagonizes potassium-dependent functions and stimulates adrenal medullary secretion of catecholamines. Early or mild symptoms of Ba excess include nausea, diarrhea, muscle stimulation, and tingling in the extremities. Later or more severe manifestations are cardiac fibrillation, loss of tendon reflexes, convulsive tremors or muscular paralysis, and respiratory distress.

Cadmium (Cd) is above the reference range. Hair Cd correlates with body burden and with past or chronic ingestion of this element. Cadmium can exert toxic effects by inhibiting sulfur -bearing enzymes and by displacing enzyme bound zinc or copper. In cells, Cd can inhibit gluconeogenesis and phosphorylation processes. Cadmium's deleterious effects may be delayed and insidious with a latent period of years before manifestations are apparent. Excessive body burden of Cd is associated with hypertension and impaired renal transport with proteinuria and urinary wasting of beta 2-microglobulin. Cd can also adversely affect the heart, bone and testes. Inhalation of Cd salts or vapors may produce emphysema. Smoking and high sugar diets appear to increase Cd levels. In children, elevated Cd has been correlated with lowered IQ.

Calcium (Ca) level is within the reference range. Hair Ca correlates with long term dietary intake, absorption from the GI tract and retention. The hair Ca level does not necessarily reflect current serum calcium or calcium ion concentrations and may not have a linear or direct relationship with tissue deposition or bone density.

Cobalt (Co) level is within the reference range.

Chromium (Cr) is within the reference range.

Gadolinium (Gd) is above the reference range. Gadolinium is a member of a group of rare earth metals known as lanthanides. It has been used for superconductors, magnets, fluorescent materials, and as a nuclear MRI contrast agent. Toxicity appears similar to nickel and copper, and has been associated with hair loss and skin lesions. These changes are consistent with Zinc deficiency and are correlated with increased urinary zinc concentrations.

Iron (Fe) is within the reference range. Please refer to note at beginning of commentary section.

Lead (Pb) is above the reference range. Hair Pb levels correlates with body tissue deposition levels (bone, aorta, liver, kidney) and also correlates with blood levels if the exposure is periodic or chronic.

At the cellular level, lead interferes with membrane transport processes and with enzyme functions because it is able to bond to many chemically active sites. The interaction of lead with sulfhydryl (SH) sites causes most of the toxic effects which include impaired heme synthesis, inhibition of erythrocyte Na, K ATPase, diminished RBC glutathione, shortened RBC life span, impaired synthesis of RNA, DNA and protein and impaired metabolism of vitamin D. Lead may also be nephrotoxic, resulting in disordered renal transport with uricemia (possibly gout), hyperaminoaciduria, glycosuria and phosphaturia. Excess body burden of Pb can be consistent with fatigue, headaches, loss of appetite, insomnia, nervousness, anemia, weight loss, decreased nerve conduction and possibly motor neuron disorders.

Magnesium (Mg) is above the reference range. Hair Mg reflects long term dietary intake, absorption from the GI tract and retention. However, hair Mg does not necessarily reflect current plasma or cellular levels. Elevated hair Mg

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usually indicates maldistribution of the element without direct correlation to blood levels. Abnormal levels or imbalances of calcium or phosphorus may result in elevated hair Mg. Elevated hair Mg may be associated with renal failure, with overall Mg excess, hypoglycemia, chronic physical or emotional stress, and hypoparathyroidism.

Manganese (Mn) is within the reference range.

Molybdenum (Mo) is within the reference range.

Nickel (Ni) is above the reference range. Hair Ni level correlates with chronic exposures and ingestion. In blood, Ni binds to albumin, globulins and amino acids, and is deposited in leukocytes. In cells, it binds to mitochondrial and cytosolic proteins. In so doing, it can displace zinc and copper, thereby activating, inhibiting, or dysregulating enzymes. A nickel exposure may hypersensitize the immune system, resulting in inflammatory responses to many environmental substances to which there was formerly little or no response. Possible symptoms of nickel excess include panallergy with rhinitis, sinusitis, conjunctivitis and asthma. Other symptoms may include vertigo, weakness and fatigue, nausea and headache. Nickel contact allergy ("nickel itch") or contact dermatitis is not necessarily reflected by elevated hair Ni.

Phosphorus (P) is within the reference range. Please refer to note at beginning of commentary section.

Potassium (K) is within the reference range. Please refer to note at beginning of commentary section.

Selenium (Se) is within the reference range.

Sodium (Na) is below the reference range. Please refer to note at beginning of commentary section.

Strontium (Sr) is within the reference range.

Sulfur (S) is within the reference range.

Tin (Sn) is above the reference range. Hair Sn correlates with past or chronic exposure. Inorganic tin is mildly toxic and may impair liver function by inhibition of the P-450 mixed function oxidase enzyme system. Hence, tin can have a synergistic effect of rendering organic chemical xenobiotics or drugs more difficult to detoxify.

Organic tin compounds - dimethyl tin, dialkyl tin, triphenyl tin - are biocidal and can be severely toxic. Exposure to organic tin compounds may produce headaches, muscle ataxia, general fatigue, vertigo and reduced sense of smell. Kidney damage may also result. Erythrocyte hemolysis, anemia and subnormal lymphocytes may occur, causing immune dysfunction. Other conditions include hyperglycemia, lesions in testes and ovaries, and inflammation or congestion of biliary ducts.

Uranium (U) is above the reference range. Hair levels of uranium may reflect past or chronic ingestion. Most exposure comes from natural uranium in ground and drinking water. The U238 isotope of uranium is measured by GSDL, and this isotope comprises more than 99% of naturally occurring uranium. Radioactivity danger from trace quantities of natural uranium is slight because of its very long half life (billions of years). The finding of elevated U238 in this test does not imply nor does it rule out exposure to enriched uranium fuel (U235) or to other radioactive isotopes which may be radiation hazards.

The major toxicological concern of U238 excess is biochemical rather than radiochemical. U is a reactive element which is able to combine with and affect the metabolisms of: lactate, citrate, pyruvate, carbonate and phosphate. Eventually, U deposits in kidney, bone, liver and spleen. The primary symptom of low level chronic uranium excess is chronic fatigue. Possible conditions from more severe uranium contaminations include damage to kidney glomeruli with disordered renal transport (proteinuria, albuminuria, and hyperaminoaciduria) and hematopoiesis in bone marrow.

Vanadium (V) is within the reference range.

Zinc (Zn) is within the reference range.