Nordic Laboratories

Test nr.
Patient Name
Patient nr.   .
Age   Sex

Doctor Name
Practitioner Address

Toxic & Essential Elements; Hair

TOXIC METALS

		RESULT µg/g	REFERENCE INTERVAL	PERCENTILE 68th / 95th
Aluminum	(Al)	1.6	< 7.0	
Antimony	(Sb)	0.011	< 0.050	
Arsenic	(As)	0.012	< 0.060	
Barium	(Ba)	0.44	< 2.0	
Beryllium	(Be)	< 0.01	< 0.020	
Bismuth	(Bi)	0.005	< 2.0	
Cadmium	(Cd)	< 0.009	< 0.050	
Lead	(Pb)	0.47	< 0.60	
Mercury	(Hg)	0.14	< 0.80	
Platinum	(Pt)	< 0.003	< 0.005	
Thallium	(Tl)	< 0.001	< 0.002	
Thorium	(Th)	< 0.001	< 0.002	
Uranium	(U)	0.006	< 0.060	
Nickel	(Ni)	0.24	< 0.30	
Silver	(Ag)	0.02	< 0.15	
Tin	(Sn)	0.11	< 0.30	
Titanium	(Ti)	0.29	< 0.70	
Total Toxic Representation				

ESSENTIAL AND OTHER ELEMENTS

		RESULT µg/g	REFERENCE INTERVAL	PERCENTILE 2.5th / 16th / 50th / 84th / 97.5th
Calcium	(Ca)	1710	300- 1200	
Magnesium	(Mg)	81	35- 120	
Sodium	(Na)	15	20- 250	
Potassium	(K)	< 3	8- 75	
Copper	(Cu)	28	11- 37	
Zinc	(Zn)	240	140- 220	
Manganese	(Mn)	0.06	0.08- 0.60	
Chromium	(Cr)	0.37	0.40- 0.65	
Vanadium	(V)	0.012	0.018- 0.065	
Molybdenum	(Mo)	0.024	0.020- 0.050	
Boron	(B)	0.24	0.25- 1.5	
Iodine	(I)	0.17	0.25- 1.8	
Lithium	(Li)	0.004	0.007- 0.020	
Phosphorus	(P)	155	150- 220	
Selenium	(Se)	0.60	0.55- 1.1	
Strontium	(Sr)	13	0.50- 7.6	
Sulfur	(S)	48300	44000- 50000	
Cobalt	(Co)	0.005	0.005- 0.040	
Iron	(Fe)	10	7.0- 16	
Germanium	(Ge)	0.028	0.030- 0.040	
Rubidium	(Rb)	0.003	0.007- 0.096	
Zirconium	(Zr)	0.017	0.020- 0.42	

SPECIMEN DATA

COMMENTS:

Date Collected:
Date Received:
Date Completed:
Methodology: ICP/MS

Sample Size: 0.196 g
Sample Type: Head
Hair Color:
Treatment:
Shampoo:

RATIOS

ELEMENTS	RATIOS	RANGE
Ca/Mg	21.1	4- 30
Ca/P	11	1- 12
Na/K	5	0.5- 10
Zn/Cu	8.57	4- 20
Zn/Cd	> 999	> 800

HAIR ELEMENTS REPORT
INTRODUCTION

Hair is an excretory tissue for essential, nonessential and potentially toxic elements. In general, the amount of an element that is irreversibly incorporated into growing hair is proportional to the level of the element in other body tissues. Therefore, hair elements analysis provides an indirect screening test for physiological excess, deficiency or maldistribution of elements in the body. Clinical research indicates that hair levels of specific elements, particularly potentially toxic elements such as cadmium, mercury, lead and arsenic, are highly correlated with pathological disorders. For such elements, levels in hair may be more indicative of body stores than the levels in blood and urine.

All screening tests have limitations that must be taken into consideration. The correlation between hair element levels and physiological disorders is determined by numerous factors. Individual variability and compensatory mechanisms are major factors that affect the relationship between the distribution of elements in hair and symptoms and pathological conditions. It is also very important to keep in mind that scalp hair is vulnerable to external contamination of elements by exposure to hair treatments and products. Likewise, some hair treatments (e.g. permanent solutions, dyes, and bleach) can strip hair of endogenously acquired elements and result in false low values. Careful consideration of the limitations must be made in the interpretation of results of hair analysis. The data provided should be considered in conjunction with symptomology, diet analysis, occupation and lifestyle, physical examination and the results of 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 upon a result of low hair copper is contraindicated in patients afflicted with Wilson's Disease.

Sodium Low

The level of Sodium (Na) in hair has not been documented to be indicative of dietary adequacy or nutritional status. Na is an essential element with extracellular electrolyte functions, but these functions do not occur in hair. Low hair Na may have no clinical significance or it may be consistent with electrolyte imbalance associated with adrenal insufficiency. In this condition, blood Na would be low, blood potassium would be high, and urinary levels of Na would be expected to be high. Observations at DDI indicate that Na and potassium levels in hair are commonly low in association with emotional stress. The low levels of Na and potassium are frequently concomitant with high levels of calcium and magnesium in hair. This apparent "emotional stress pattern" 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 Low

The level of Potassium (K) in hair does not reflect nutritional status or dietary intake. However, hair K levels may provide clinically relevant information pertaining to adrenal function and/or electrolyte balance.

K is an electrolyte and a potentiator of enzyme functions in cells, but neither of theses functions takes place in hair. K can be low in the body as the result of gastrointestinal or renal dysfunction, or as a side effect of some diuretics. In adrenocortical hyperactivity, blood levels of K are depressed, while urinary K is increased. Low hair K should be viewed as a screening test. Observations at DDI indicate that hair levels of sodium and K are commonly low in association with emotional stress. The low levels of sodium and K are frequently concomitant with high levels of calcium and magnesium in hair. This apparent "emotional stress pattern" requires further investigation.

Symptoms of true K deficiency include: muscle weakness, fatigue, and tachycardia. Diabetic acidosis can result in severe K loss.

Confirmatory tests for K deficiency include measurements of packed red blood cell K; whole blood K and the sodium/K ratio; urine K and the sodium/K ratio. An electrocardiogram may show abnormalities when K is low in serum/plasma or whole blood.

Copper Normal

Hair Copper (Cu) levels are usually indicative of body status, except that exogenous contamination may occur giving a false normal (or false high). Common sources of contamination include: permanent solutions, dyes, bleaches, and swimming pools/hot tubs in which Cu compounds have been used as algaecides.

Cu is an essential element that activates specific enzymes. Erythrocyte superoxide dismutase (SOD) is a Cu (and zinc) dependent enzyme; lysyl oxidase 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.

If hair Cu is in the normal range, this usually means tissue levels are in the normal range. However, under circumstances of contamination, a real Cu deficit could appear as a (false) normal. If symptoms of Cu deficiency are present, a whole blood or red blood cell elements analysis can be performed for confirmation of Cu status.

Zinc High

A result of high hair Zinc (Zn) may be indicative of low Zn in cells, and functional Zn deficiency. Zn can be displaced from proteins such as intracellular metallothionein by other metals, particularly cadmium, lead, copper, and mercury (Toxicology of Metals, 1994), resulting in paradoxically elevated hair Zn. Zn may also be high in hair as a result of the use of Zn-containing anti-dandruff shampoo. Rough or dry, flaky skin is a symptom of Zn deficiency, so it is not uncommon for Zn deficient patients to use an anti-dandruff shampoo. A result of high hair Zn warrants further testing to assess Zn status.

Zn is an essential element that is required in many very important biological processes. However, Zn can be toxic if exposure is excessive. Although very uncommon, high hair Zn might be indicative of Zn overload which could result from Zn contaminated water (galvanized pipes), welding or gross, chronic over-supplementation (100 mg/day). Other sources of Zn include:

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manufacture of brass, bronze, white paint, and pesticide production. Symptoms of Zn excess include: gastrointestinal disorders, decreased heme synthesis (copper deficiency), tachycardia, blurred vision, and hypothermia.

Confirmatory tests for Zn status are whole blood or packed red blood cell elements analysis, urine amino acid analysis, and serum ceruloplasmin (low with Zn induced copper deficiency).

Manganese Low

Hair Manganese (Mn) levels correlate well with Mn levels in other body tissues. Hair Mn levels are commonly low, in part due to low dietary Mn intake and the interaction of Mn with phosphates in the gut. Intestinal malabsorption also limits Mn uptake.

Mn is an essential element that is involved in energy metabolism, and bone and cartilage formation. Mn is an activator of many important enzymes including: mitochondrial superoxide dismutase, arginase, and pyruvate carboxylase.

Symptoms associated with Mn deficiency include: fatigue, lack of physical endurance, slow growth of fingernails and hair, impaired metabolism of bone and cartilage, dermatitis, weight loss, and reduced fertility. Increased allergic sensitivities and inflammation are often associated with low Mn. Seizures are occasionally reported to be associated with severe Mn deficiency.

An appropriate laboratory test to confirm Mn deficiency is whole blood elements analysis.

Chromium Low

Hair Chromium (Cr) is a good indicator of tissue levels and may provide a better indication of status than do urine or blood plasma/serum (Nielsen, F.H. In Modern Nutrition on Health and Disease; 8th Edition, 1994. Ed. Shils, Olson and Shike. Lea and Febiger, Philadelphia). Hair Cr is seldom affected by permanent solutions, dyes and bleaches.

Cr (trivalent) is generally accepted as an essential trace element that is required for maintenance of normal glucose and cholesterol levels; it potentiates insulin function, i.e., as a part of "glucose tolerance factor". Deficiency conditions may include hyperglycemia, transient hyper/hypoglycemia, fatigue, accelerated atherosclerogenesis, elevated LDL cholesterol, increased need for insulin and diabetes-like symptoms, and impaired stress responses. Marginal or insufficient Cr is common in the U.S., where average tissue levels are low compared to those found in many other countries. Low hair Cr appears to be associated with increased risk of cardiovascular disease and an atherogenic lipoprotein profile (low HDL, high LDL). Common causes of deficiency are ingestion of highly processed foods, inadequate soil levels of Cr, gastrointestinal dysfunction, and insufficient vitamin B-6. Cr status is also compromised in patients with iron overload/high transferrin saturation because transferrin is a major transport protein for Cr.

Confirmatory tests for Cr adequacy include glucose tolerance and packed red blood cell elements analysis.

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Vanadium Low

Vanadium (V) is typically found at low levels in hair and the clinical significance of the measured result of lower than average hair V is not known. V is measured in hair for research purposes because it has been postulated to be an essential microtrace element. Indirect data to support this postulate have been derived from experimental models. Suggested functions for V include: regulation of sodium-potassium-ATPase, intracellular glutathione metabolism, thyroid metabolism, and insulin mimetic effects at pharmacological doses.

Average dietary V intake varies considerably between 20 mcg to 2 mg. Food sources of V include: liver, fish, radishes, grains, nuts, and vegetable oils.

Boron Low

Boron (B) is normally found in hair, but the correlations among dietary B intake, and tissue and hair levels of B have yet to be established. Recent studies clearly indicate that B has an important role in normal bone metabolism/density and may be needed for normal membrane function. In post-menopausal women consuming a very low B diet, B supplementation significantly lowered urinary excretion of calcium and magnesium and increased serum levels of estrogen (Environ. Health Persepct.; 102 Supl.7: 59-63, 1994). Further research is in process to determine the clinical significance of hair B levels.

Strontium High

Hair usually reflects the body burden of Strontium (Sr), and Sr levels usually correlate with calcium levels in body tissue. However, hair levels of Sr can be raised by external contamination, usually from hair treatment products. Elevated Sr in hair treated with permanent solutions, dyes, or bleaches is likely to be an artifact of hair treatment and probably does not reflect the level of Sr in other tissues.

Diseases of excess Sr have not been reported, except for Sr rickets. In general, Sr excess is not of clinical concern in the U.S.   It's bad reputation comes from it's radioactive isotopes which were widespread in the western U.S. as a result of nuclear testing in the 1950's. Stable Sr (not radioactive Sr) is measured and reported by DDI.

Other tests indicative of Sr status or excess are measurements of Sr in whole blood, Sr/calcium ratio in blood, and Sr in urine.

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. For example, the combined presence of lead and mercury will give a higher total score than that of the combination of silver and beryllium.