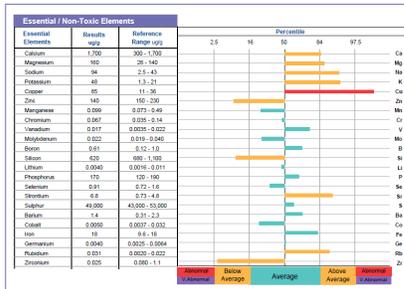


### Elemental Analysis of Hair

The quantitative measurement of elements in biological samples such as blood, urine, and hair has been used clinically for decades. Historically, elemental analysis has been used primarily to determine whether a person has had excessive exposure to toxic elements such as lead, mercury or arsenic: the so called *heavy metals* that are known to cause serious health problems. Toxic elements concentrate in soft tissue rather than blood or urine, so hair analysis is uniquely suited for measuring toxic elements. Elemental analysis also provides information on the absorption and assimilation of nutritionally important elements (e.g. iron, copper), making it useful for assessing nutrient deficiencies and imbalances as well.



normal essential element distribution

### Essential Element Distribution

The graph below shows a normal distribution pattern of essential elements from the hair of a healthy individual. A normal pattern exhibits a fairly balanced distribution of results above and below the mean, with most results reporting within one standard deviation. A normal essential element pattern will still have some yellow or red bars.

A careful review of essential element distribution is crucial to the overall interpretation of hair element analysis. Andrew Hall Cutler PhD spent years analyzing patterns in hair element test results. Dr. Cutler's extensive research lead him to conclude that essential element distribution is the single most important factor in interpreting multiple element results in hair. When the majority of essential elements are normal, then both essential and toxic element results can be taken at face value. However, when essential element distribution is abnormal, it is highly probable that overall element transport has been disrupted. A major cause of excesses or deficiencies of essential elements is the presence of toxic elements like mercury. However, essential element distribution can also be affected by genetics and/or poor digestion.



### Toxic Elements Nutritional Elements

Hair element analysis can be used to look for exposure to toxic elements and/or determine levels of essential elements

### Causes of Disrupted Essential Element Distribution

Understanding how essential element disruption occurs is vital to interpreting hair element analysis reports. Elements are transported into hair and other tissues via active transport systems. Active transport requires specific nutrients and essential elements as cofactors to produce energy to accomplish transport. Therefore, any disruption in the normal distribution of essential elements or nutrients can affect active transport and further alter the distribution of elements to hair and other tissues. In addition to toxic element accumulation, nutrient deficiency and/or genetic abnormalities can also affect element transport. Thus, disruption of essential element distribution can arise from any of the following:

- ▶ inhibition or induction of active transport systems by toxic elements.
- ▶ malabsorption of nutrients needed for active transport.
- ▶ excesses or deficiencies of one or more elements diverting other elements out of, or into, targeted tissues or fluids (e.g. excess Fe displaces Cr causing increased hair Cr).
- ▶ a genetic predisposition to accumulate or excrete more than usual amounts of specific elements.
- ▶ disruption/alteration of bile flow leading to impaired excretion of heavy metals and thus an impaired essential element pattern.



## Guide to Interpreting Results

When element transport systems are functioning normally, hair reflects body stores of most elements very well. A normal essential element distribution pattern is a good indicator that the transport system is functioning properly (Figure 1 previous page). Conversely, an abnormal distribution pattern may suggest a transport problem. Graphs and explanations of the common distribution patterns are provided below.

### Abnormal essential element distribution patterns

There are several potential abnormal distribution patterns for essential elements and treatment indications may vary as a result. The abnormal patterns include the following:

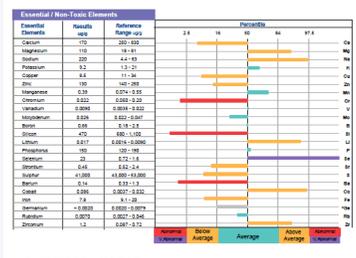
- too many essential elements reporting too far above and below the mean (scattered)
- too many essential elements testing above the mean (right shifted)
- too many essential elements testing below the mean (left shifted)
- too many elements more than 3 standard deviations above or below the mean (widely scattered)

## Toxic elements

Given the close relationship between essential elements and toxic elements, the precise cause of high or low values for toxic elements can be difficult to determine. For example, a finding of low hair mercury does not rule out the possibility that toxic levels of mercury are present in the body. Abnormal distribution of essential elements provides a clue that active transport systems have been disrupted, perhaps by toxic element poisoning of transport systems. Thus, high systemic levels of mercury could actually prevent transport of mercury into hair. In such a case, low hair mercury levels might in fact be a false negative result.

Ultimately, element distribution is a complex interactive system that can be affected by numerous variables. Consequently, when interpreting the hair element analysis reports, careful consideration must be given to all relevant factors.

## Abnormal Essential Element Distribution



Widely scattered

A **scattered** pattern is characterized by the presence of fewer than 12 green bars.

A **widely scattered** pattern occurs if there are 4 or more red or purple bars.

- toxic element accumulation
- genetic predisposition to accumulate or excrete specific elements

### Supplement considerations

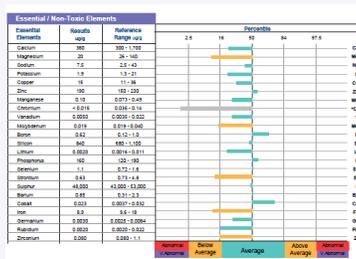
- B vitamins, vitamin C, mixed tocopherols, mixed carotenoids, omega 3 fatty acids
- Oral chelation removes toxic elements, but in some cases also removes essential elements.

Common chelating agents include:

- DMSA (dimercaptosuccinic acid) is a water soluble chelating agent used primarily to chelate lead, but may remove essential elements as well.
- DMPS (2,3-dimercapto-1-propanesulfonic acid): chelates both toxic and essential elements. Used for decades in Europe to chelate mercury.
- EDTA (ethylenediaminetetraacetic acid): FDA-approved treatment for chelation of lead, mercury, aluminum and cadmium.
- MCP (modified citrus pectin) safely and effectively chelates lead, arsenic, mercury and other toxic elements without affecting essential element levels.
- chlorella, cilantro, alpha-lipoic acid are sometimes used to chelate mercury.
- MSM (methylsulfonylmethane).

### Additional supplements to consider for left shifted patterns

- enzymes and/or bile salts to aid digestion.
- betaine hydrochloride to increase gastric acid/improve digestion.
- milk thistle and other supplements to detoxify and improve liver function.

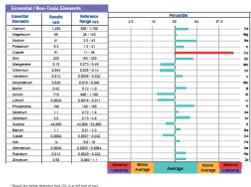


Left Shift

A **left-shifted pattern** shows most (>18) bars to the left of the mean. This pattern may be found if:

- a patient is consuming a diet markedly depleted in essential elements
- there is poor absorption of essential elements as a result of insufficient gastric acid and/or pancreatic enzymes (which could be a symptom of toxic element accumulation).

# Normal Essential Element Distribution



normal essential element distribution



elevated mercury

Normal essential elements, isolated high toxic elements

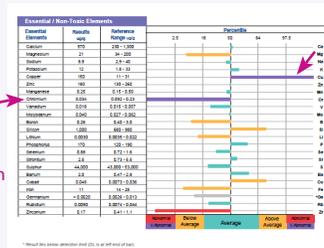
A normal distribution pattern for essential elements means isolated high levels of toxic elements can be taken at face value. For example:

- high mercury with normal essential element distribution suggests that the body burden of mercury is elevated but has not impaired the transport of elements.

## Normal essential elements, high toxic elements

- Oral chelation removes toxic elements, but in some cases also removes essential elements. Common chelating agents include:
  - DMSA, DMPS, EDTA, and modified citrus pectin.

Careful supervision of oral and intravenous chelation therapies is critical to ensure that essential element levels are not adversely affected.



low chromium

elevated copper

Isolated high or low levels of essential elements

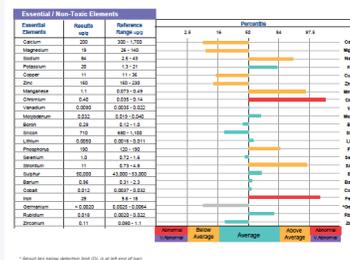
A basically normal distribution pattern for essential elements means that isolated high or low levels of essential elements should be treated appropriately. For example:

- low chromium in the face of normal essential element distribution patterns suggests chromium supplementation may be beneficial.
- high copper in the face of an overall normal distribution pattern, could indicate oversupplementation with copper.

## Isolated low and high levels of essential elements

- for deficiencies of essential elements, supplementation with the deficient element should be considered.
- for high levels of essential elements, consider revising diet and/or supplement intake. Also investigate possible occupational or lifestyle exposure.

# Stress Patterns



Sodium/Potassium greater than Calcium/Magnesium

When results for sodium/potassium pair are more than one unit away from calcium/magnesium pair:

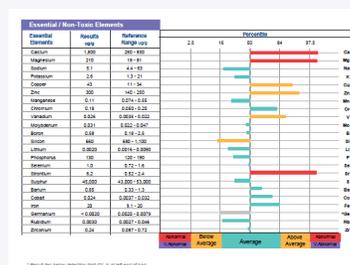
- this pattern is more common in individuals making excess adrenaline and insufficient cortisol.
- this pattern may indicate an imbalance between dietary copper and zinc (too much copper relative to zinc).

## Supplements

- theanine
- holy basil
- 5-HTP
- tyrosine
- rhodiola
- adrenal supportive supplements to boost cortisol production
- balance copper and zinc intake

## Lifestyle considerations

- avoid stimulants
- utilize relaxation techniques
- adequate protein intake, especially between meals, as well as slow-release, complex carbohydrates (to stabilize blood sugar).



Calcium/Magnesium greater than Sodium/Potassium

When results for calcium/magnesium pair are higher (more positive) than sodium and potassium and the ends of the two groups of bars are at least one unit apart.

- this pattern is thought to be more common in severe adrenal fatigue, where both cortisol and adrenaline are low.

## Interventions

As for adrenal fatigue:

- Methyl donors and copper to promote epinephrine synthesis.
- Avoidance of refined carbs to minimize need for insulin counterregulatory hormones cortisol and epinephrine.

## Potential sources of element exposure

In addition to intentional or inadvertent ingestion, there are a number of other potential sources of exposure to either essential or toxic elements. The following is a brief summary of some common exogenous sources of elements:

### Lifestyle influences on element levels

- ▶ Exercise increases sodium and potassium and lowers calcium and magnesium levels.
- ▶ Medicated shampoos: anti-dandruff shampoos may contain zinc or selenium. Solutions used to hide gray hair may contain lead.
- ▶ Daily swimming in chlorinated pools can raise copper and sodium levels.
- ▶ Exposure to toxic elements at the workplace or home can elevate levels of those toxic elements in hair.

### Medication influences on element levels

- ▶ Diuretics deplete the body of sodium and/or potassium.
- ▶ Lithium may lower sodium levels.
- ▶ Anti-perspirants contain aluminum and may elevate hair aluminum.

Essential / Toxic	Result	
Average / Normal	Results displayed as green bars are in the normal range for a healthy population (result lies within one standard deviation [SD] of the mean).	68% of results lie in this range
Above average / High normal	Results displayed as orange bars are still within acceptable limits, but are higher than average for a healthy population (result lies more than one SD, but less than 2 SDs, higher or lower than the mean).	27% of results lie in this range
Abnormal / High	Results displayed as red bars are considered abnormal relative to a healthy population (result is more than 2 SDs but less than 3 SDs higher or lower than the mean).	5% of results lie in this range
Significant Abnormal Very High	Results displayed as purple bars are significantly abnormal relative to a healthy population (result is more than 3 SDs higher or lower than the mean).	less than 1% of results lie in this range.

### Hair washing

Whether or not to wash a hair sample prior to analysis is a much debated question in the field of hair element analysis. Extensive testing of various washes by Rocky Mountain Analytical found the results from washed samples to be comparable to other testing laboratories employing a wash procedure. A reduction in the concentration of the lighter elements (Na, K, Rb, Li) was observed with all wash procedures. Analysis of unwashed hair introduces the possibility of external contamination and false positive results.

### Element ratios

Many practitioners examine the ratios of various elements (e.g. Ca/Mg: calcium/magnesium, Na/K: sodium/potassium, Zn/Cd: zinc/cadmium) for signs of endocrine problems like metabolic syndrome and adrenal fatigue. The same caveats which apply to the individual elements also apply to the ratios: care must be taken not to over-interpret element ratios. In other words, the patient's clinical picture should always be considered prior to acting on laboratory results.

### Reporting format

The report has four sections: toxic element results, essential element results, element ratio results, and the interpretation. The results for all the elements are displayed with reference to age and gender-matched normal, healthy individuals. Our custom software automatically assesses the distribution pattern of the essential elements, and determines whether it is normal or abnormal. The first part of the interpretation describes this assessment. The results (both the individual elements and the various ratios) are then discussed in the context of the underlying "tone", i.e. normal or deranged element transport.

### Detection Limits

It is impossible to accurately portray a result which lies below the detection limit of the instrument. In such cases, we display a gray bar to indicate the area of the detection limit. If you see a gray bar for an essential element, it means that the patient result lies somewhere lower than the the gray bar. For toxic elements, the result lies somewhere within the gray bar.

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