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# HTMA Mineral Ratios

## A Brief Discussion of their Clinical Importance

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We frequently receive questions from new clients asking just what the mineral ratios represent or are indicative of in the HTMA report. Therefore, I think I need to reiterate some of the reasons we show a representation of these mineral ratios on the graph, which include the "Significant Ratios", "Toxic Ratios" and "Additional Ratios". As we have stated many times over the past 25 years, the mineral ratios are often more important than the individual mineral levels themselves and this can be illustrated by the following statements by Vitale, et al., "Determining nutritional interrelationships is much more important than knowing mineral levels alone. From a global standpoint, although dietary deficiency is at the more serious end of the spectrum, the opposite end, dietary excess and aberrations contribute to the burden of disease." "Mild and subclinical deficiencies of nutrients outnumber overt syndromes ten to one."

### - Significant Ratios -

The section of the graph depicting the significant ratios include calculations of the following mineral relationships; Calcium relative to Phosphorus (Ca/P), Sodium relative to Potassium (Na/K), Calcium relative to Potassium (Ca/K), Zinc relative to Copper (Zn/Cu), Sodium relative to Magnesium (Na/Mg), Calcium relative to Magnesium (Ca/Mg) and Iron relative to Copper (Fe/Cu). These select mineral ratios reveal not only the important balance between these elements, but they also provide information regarding the many possible factors that may be represented by a disruption of their relationships, such as disease states, physiological and developmental factors, the effects of diet, drugs,

neurological and endocrine effects.

Although these are represented as "significant ratios" which are obviously very important, we actually evaluate many more mineral interrelationships and their subsequent calculations in generating a final report of the laboratory results. A complete and comprehensive discussion of all mineral relationships, the multitude of their physiological factors, etc, would simply be far too extensive to discuss in this short presentation. Also, rather than discuss the many synergisms between these minerals and their biological and physiological functions, I will restrict my explanations at this time to the major factors they represent.

### - Ca/P Ratio -

The ideal Ca/P ratio or balance is 2.6 to 1. In other words there should be found 2.6 times more calcium relative to phosphorus found in the hair. However, the ideal or preferred range can vary from 1.8 to 3.6. The autonomic nervous system (ANS) is represented by the Ca/P relationship. Calcium is controlled by the parasympathetic branch of the ANS. When the parasympathetic side of the ANS is dominant there is an increased accumulation of calcium relative to phosphorus. Calcium accumulation is also affected by posterior pituitary dominance producing a cascade of what can be termed the parasympathetic endocrine system. Generally, it can be stated that the parasympathetic nervous system and parasympathetic endocrine system is sedative and produces a relative reduction in metabolic activity. This in turn affects the body type contributing to the pearshaped body structure. This

would also predispose a person with parasympathetic dominance to certain health conditions if severe or chronic. Of course the ANS affects several other minerals and their interrelationships as well, that have been discussed in previous issues of the Newsletter.

The sympathetic nervous system controls or greatly impacts the mineral phosphorus. When dominant there is an increased accumulation of phosphorus relative to calcium within the hair. This is represented by a reduction in the Ca/P ratio. Sympathetic dominance is associated with anterior pituitary dominance which creates a sympathetic endocrine cascade that also contributes to phosphorus retention relative to calcium. Sympathetic dominance can generally be described as having a stimulatory effect on the metabolic rate. This leads to the appleshaped body type as well as predisposition to specific health conditions when severe or chronic. Again, it should be noted that other minerals are also affected.

#### **- Na/K Ratio -**

Ideally there should be a 2.4:1 ratio of sodium relative to potassium with a range of 1.4 to 3.4 being acceptable. Sodium and potassium reflect expression of the adrenal cortical hormones as well as renal control. Of course other hormones affect these electrolytes as well, but I will focus on the adrenal hormones here. Both sodium and potassium are sensitive to the effects of various types and stages of stress as well as inflammation and antiinflammation.

When sodium is dominant relative to potassium, greater than five to one, an inflammatory response may be in effect. This is also related to an alarm stage of stress. Increased production of the adrenal cortical hormone aldosterone is increased in the presence of inflammation, or aldosterone may initiate inflammation. Aldosterone also greatly impacts sodium retention within the body and the hair via increased retention and conservation by the kidneys.

When the ratio of Na/K is found low in the hair it can represent a number of factors. For instance, a low Na/K ratio may be related to an anti-inflammatory reaction. Glucocorticoids and cortisol released from the adrenal cortex enhances the retention of potassium and influences the kidneys to conserve potassium. The lower the Na/K ratio the more chronic this stage of resistance has become. If chronic, the increased glucocorticoids will result in protein catabolism. A low Na/K ratio can also indicate a disturbance in neurological and/or renal function. It should be noted that heavy metals such as cadmium and lead can affect the Na/K relationship due to their affect upon renal function. Cadmium particularly, will produce an aldosterone effect. The nutritional minerals such as

calcium, phosphorus, copper, iron, manganese, magnesium, lithium rubidium and others will impact the Na/K ratio as well.

#### **- Ca/K Ratio -**

Ideal ratio of 4.2:1 with an acceptable ideal range of 2.2 to 6.2. Calcium is affected by several hormones and is considered to be under parasympathetic control. Therefore, the hormone cascade that affects the retention of calcium also affects thyroid expression. Elevation of the Ca/K ratio can be indicative of reduced thyroid expression. The opposite, a low Ca/K ratio would indicate an elevation of thyroid expression. This ratio would also be associated with adrenal activity. The Ca/K ratio can also be affected by iron, zinc, copper, selenium, lithium, cobalt, molybdenum and others.

#### **- Zn/Cu Ratio -**

The ideal ratio between zinc and copper is 8:1 with an acceptable range from 4 to 12. The minerals zinc and copper are influenced by several physiological factors, as well as hormonal factors, including estrogen, progesterone and testosterone. Zinc is necessary for the production of progesterone and testosterone, while copper is influenced by estrogen.

Elevation of the Zn/Cu ratio would give an indication of progesterone and testosterone dominance relative to estrogen. A low Zn/Cu ratio would indicate the reverse, an elevation of estrogen relative to progesterone and testosterone. Zinc and copper are also related to the antioxidant activity of superoxide dismutase (SOD). Their balance would reflect the activity of zinc and copper activated SOD. This ratio is affected by physiological conditions such as pregnancy, growth and development. Virus and bacterial infections can also influence the Zn/Cu ratio.

#### **- Na/Mg Ratio -**

Ideal ratio of 4:1 with an acceptable range from 2 to 6. As mentioned previously, sodium is regulated by the adrenal hormones and an elevated ratio indicates increased adrenal cortical activity. Magnesium deficiency is known to increase the stress response so the lower the magnesium level is found in the hair, the greater the stress response. The stage of stress can be determined when viewing the Na/K ratio in relation to the Na/Mg ratio. A low hair Na/Mg ratio would indicate a reduced adrenal expression.

#### **- Ca/Mg Ratio -**

Ideal ratio of 7:1 with an acceptable range from 3 to 11. Calcium and magnesium are regulated by the parathyroid, thyroid and estrogen, as well as through renal function. A markedly elevated Ca/Mg ratio reflects

the potential for parathyroid hormone dominance. This is also associated with increased insulin levels as well. A low Ca/Mg ratio reflects the potential for low insulin levels and elevated adrenal cortical hormone production.

#### **- Fe/Cu Ratio -**

Ideal ratio of 0.9:1 and an acceptable ideal range from 0.2 to 1.6. The relationship between iron and copper are important for many reasons. They are involved in cellular respiration and electron transport. Therefore, a disruption in their equilibrium can lead to serious consequences in normal cellular activity. An elevated Fe/Cu ratio leads to increased free radical production, particularly lipid peroxidation that can lead to mitochondrial damage. The corresponding reduction in copper increases the damage from superoxide radicals due to the suppression of copper activated SOD. The ratio of Fe/Cu either high or low can also lead to neurological dysfunction affecting neurotransmitters and causing lipid peroxide damage within neurological tissues. An elevation or reduction in the Fe/Cu ratio is associated with a decrease in the utilization of iron by affecting the ability to incorporate iron into hemoglobin. An elevated Fe/Cu ratio in the hair may indicate a potential for chronic bacterial infection. A low Fe/Cu ratio can be associated with iron deficiency as well as thyroid disturbance.

#### **- Toxic Ratios -**

The toxic ratio section of the graph has been frequently misunderstood as well. This section graphically shows the relationships of the protective nutrient minerals relative to the heavy metals. There is no standard range associated with the toxic ratios, only a low or acceptable level. Since everyone is exposed and has heavy metals ever present in their body, the higher the toxic ratios the better. However, there is no clinical significance of the ratios being double, triple or even ten times higher than the minimal acceptable level. As an example, the Ca/Pb ratio has an acceptable level of 84:1. Since calcium reduces lead absorption and retention within the body, calcium is considered protective of excess lead retention. The ratio of calcium to lead should be at least 84 times higher than lead in order to be protective or to prevent the adverse effect of lead within the body. A Ca/Pb ratio below 84:1 would indicate a potential for lead interfering with metabolic processes. Heavy metals interfere with normal metabolic processes due to their ability to displace nutritional minerals or poison enzyme function by their attachment to proteins. For example, cadmium has a very similar structure as the mineral zinc. Cadmium also has a higher atomic weight. When cadmium enters the body, and if not excreted, will become stored in tissues.

If adequate amounts of zinc are not present within the cell to be protective, cadmium can then displace zinc. Another example would be that if the heavy metal mercury enters the cell in an environment of nutritional inadequacy of sulfur iron, or selenium, mercury will attach to the proteins involved in enzyme activation and disrupt their function. In reviewing the significant ratios we should keep in mind that hormonal factors also have an influence on heavy metal accumulation within the body. For example sympathetic neuroendocrine dominance generally can enhance the retention of lead, while excess parasympathetic activity can enhance the retention of cadmium or mercury.

#### **- Additional Ratios -**

This section of the graph depicts the known relationships between many of the macro nutritional elements and the additional trace elements that we report. For example, the mineral copper and molybdenum are mutually antagonistic with an expected ratio of 625 to 1. If this ratio is elevated, it is indicative of excessive amounts of tissue copper being present relative to molybdenum levels. This imbalance could negatively impact the molybdenum enzymes related to detoxification. Another example would be the magnesium to boron ratio, which is expected to be approximately 40 to 1. If this ratio is low, boron could be interfering with magnesium especially when the Ca/Mg ratio is also elevated. At this time, although we do not discuss these to any extent within the report, more information will be reported as research indicates. However, we are aware of the antagonistic relationships of many of these minerals and we do report the "expected" ratio values, even though a specific "acceptable" ratio reference range is not provided at this time.

#### **- Conclusion -**

There are a vast number of factors that can intricately affect the relationships between minerals within the body, and these should also be taken into consideration when evaluating a mineral profile. Our continuing research and the HTMA laboratory reports based upon this research evaluate vitamins, foods, drugs, water, disease, xenotoxins and normal physiological conditions that may individually or collectively play a role in contributing to mineral imbalances. As a clinical screening test, HTMA can provide a critical window to the imbalances that may be present in an individual, and through proper interpretation of this data can provide a specific and targeted approach to therapy, when used in conjunction with the patient's history and other clinical information.