Lifestyle, minerals and health

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Summary  This paper proposes that most poor health and behavioral conditions are related to a deficiency of essential minerals or an excess of toxic ones. Clients requesting a hair mineral analysis were required to complete a questionnaire including lifestyle, health status and diet. Most prevalent health conditions in order of frequency were: depression, allergies, low back pain, arthritis, cardiovascular disease and poor digestion. Most deficient minerals were chromium, magnesium, zinc and calcium. Aluminum was the most frequent toxic mineral. It is proposed that such mineral abnormalities were caused by an over consumption of nutrient-poor, highly processed foods such as white flour, sugar and harmful fats. Such a diet promotes poor lifestyles such as smoking, drug abuse, alcoholism and criminal activity. Poor diets and dangerous lifestyles precedes the development of most prevalent diseases. The most common one is cardiovascular disease which increased at an alarming rate in the last century. © 2001 Harcourt Publishers Ltd

INTRODUCTION

This paper will examine the general topic of minerals, inappropriate behavior and human health. It involves the mineral levels of the most recent hair samples from 2000 clients. It will deal specifically with the 12 most deficient essential minerals and five toxic ones (Tables 1 and 2). Most of the samples came from people living in Western Canada. They varied in age from 5 to 85; slightly more females than males availed themselves of this service. An important prerequisite for a hair analysis, is the completion of a four-page questionnaire.

It should be emphasized, that minerals are essential for all living organisms. Their importance for plants was recognized and carefully studied by soil and plant scientists long before that of humans. Early in this century the Dole pineapple growers in Hawaii, began analyzing plant tissue for mineral adequacy. This procedure was so effective the principle was eventually applied to animals and humans, using hair tissue in a similar manner.

Table 1  Percent of 2000 clients deficient in 12 essential minerals

<table>
<thead>
<tr>
<th>No.</th>
<th>Mineral</th>
<th>Deficient (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chromium (Cr)</td>
<td>56</td>
</tr>
<tr>
<td>2</td>
<td>Magnesium (Mg)</td>
<td>49</td>
</tr>
<tr>
<td>3</td>
<td>Zinc (Zn)</td>
<td>47</td>
</tr>
<tr>
<td>4</td>
<td>Calcium (Ca)</td>
<td>46</td>
</tr>
<tr>
<td>5</td>
<td>Manganese (Mn)</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>Selenium (Se)</td>
<td>40</td>
</tr>
<tr>
<td>7</td>
<td>Potassium (K)</td>
<td>37</td>
</tr>
<tr>
<td>8</td>
<td>Iron (Fe)</td>
<td>25</td>
</tr>
<tr>
<td>9</td>
<td>Copper (Cu)</td>
<td>25</td>
</tr>
<tr>
<td>10</td>
<td>Molybdenum (Mo)</td>
<td>15</td>
</tr>
<tr>
<td>11</td>
<td>Phosphorus (P)</td>
<td>9</td>
</tr>
<tr>
<td>12</td>
<td>Sodium (Na)</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 2  Percent of 2000 clients with toxic minerals

<table>
<thead>
<tr>
<th>No.</th>
<th>Mineral</th>
<th>Excess (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aluminum (Al)</td>
<td>9.4</td>
</tr>
<tr>
<td>2</td>
<td>Lead (Pb)</td>
<td>3.0</td>
</tr>
<tr>
<td>3</td>
<td>Cadmium (Cd)</td>
<td>0.8</td>
</tr>
<tr>
<td>4</td>
<td>Arsenic (As)</td>
<td>0.1</td>
</tr>
<tr>
<td>5</td>
<td>Mercury (Hg)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

One of the first examples of this was done in 1961 when Napoleon’s hair was analyzed (1). It was found to have 100 times the normal average values for arsenic. He could have been poisoned or taken it in medication.
Dr Wm. Strain of the Cleveland Metropolitan General Hospital, Cleveland Ohio was one of the earliest researchers in this field. In the 1960s, using a group of healthy young marines, he established the normal levels of both the essential minerals and the toxic ones for both sexes. Since then, these levels have been refined as indicated by research. He reported in 1966 that zinc deficiency in man could be determined by hair mineral analysis (2). This author pioneered a service in the 1970s to measure body minerals using the procedure developed by Dr Strain. Since then, he has analyzed many thousands of hair samples (3,4).

We are moving away from the belief that medicine's main purpose is to cure disease, to that of prevention. Hair mineral analysis as a diagnostic tool, had its extreme critics. By 1983 there were 1500 citations in the scientific literature. A group of responsible physicians established the Hair Analysis Standardization Board in 1981 (5).

**METHODS**

The author established a service, _Diet, Lifestyle and Hair Mineral Analysis_ in 1975. When requested, a hair analysis kit is provided. It contains a plastic container for the sample, an illustrated paper balance card describing how to measure the correct amount of hair (~1 g). Page one of the questionnaire includes name, sex, age, occupation and hair treatments. The second page lists 38 common health conditions, such as heart disorders, cancer and diabetes, the client has. Page three is devoted to 27 questions related to diet and lifestyle. The last page includes a summary of the client's supplement program as well as medications taken routinely. The analysis concentrates on the measurement of 18 essential minerals and five toxic ones. This information is essential in order to make a valid overall assessment and useful recommendations. The main emphasis is on getting the client's mineral status, general health and lifestyle improved. This paper includes an analysis of the results of 2000 recent clients.

**ESSENTIAL MINERAL DEFICIENCIES**

**Chromium (Cr) 56%**

The essentiality of chromium wasn't established until recently by Dr Walter Mertz (6), yet it was the most deficient essential mineral in those tested. To prevent deficiencies, one needs to take only 200 μg daily. Perhaps it is time to adapt Liebig's Law for humans, as follows: 'The state of any human's health depends on that mineral in least supply'. He recognized that the average diet is not supplying sufficient chromium. The increasing consumption of very low chromium refined carbohydrates, especially white flour and sugar is the main reason (7). Some of the early writers warning of the dangers of too much sugar are: Cleave (8), Yudkin (9), Dufty (10), and Abrahamson (11). According to Dr Appleton, some popular foods in this category are: candies, cookies, cakes, pies, puddings, doughnuts, muffins, soft drinks, fruit juice, ice cream, most packaged cereals, ketchup, beer, tobacco and even chewing gum (12).

The Hellers explain that Chromium GTF (Glucose Tolerance Factor) is required to produce energy from blood sugar (13). Without this close control, blood sugar could damage the cells. Manganese and vitamin B3 (niacin) are also required. Dr Appleton reports that the annual consumption of sugar in the U.S.A is approximately 130 pounds per capita (30 tsp per day) or 20% of their calories. This ubiquitous product comes in many forms, such as honey, maple syrup, molasses, glucose, dextrose, levulose, maltose, corn syrup, rice syrup and brown sugar (12).

The conversion of these simple chromium-deficient carbohydrates to glucose, results in a depletion of body stores of this critical mineral and a concomitant increase of insulin. Since no chromium is present in sugar, it is depleted from the body stores. The result is that organs and glands are overworked, leading to malfunction and eventually to degenerative diseases. Examples are depression, adult-onset diabetes, high blood pressure and heart disease, stroke, obesity, tooth decay and plaque buildup, osteoporosis, high cholesterol (especially LDL), and triglycerides, gout and certain forms of cancer (12).

The body loses chromium when under severe stress, both mental and physical (13). The high phosphorus in milk binds up chromium. This partially explains why so many milk-drinking Americans have a high rate of depression and obesity (12).

Good food sources of chromium are: Brewer's yeast, beef, calves liver, whole grain products, potatoes, wheat germ, green pepper, hen's eggs and apples (5).

**Magnesium (Mg) 49%**

When magnesium is deficient, there is probably no other mineral responsible for more physical and mental disorders. Like calcium, most of it (70%) is in the bones and teeth. The remainder is in the soft tissues such as the muscles, heart, liver, pancreas and external fluids It is especially important in growing children, pregnant, lactating or menstruating women and older people. In addition to its key role in bone health, it is also involved in cellular metabolism and as many as 300 enzyme systems. It is an intracellular mineral required for the conversion of glucose to glucose-6-phosphate. This is the first step in carbohydrate metabolism. It is essential in the Kreb's cycle in which pyruvate is changed to coenzyme A. Magnesium is involved in protein production and the control of energy through ADP and ATP.
Deficiency symptoms include poor appetite, irritability, weakness, muscle tremor, tetany, twitching, numbness, tingling, disorientation, learning disability, apathy, memory loss, skin lesions, elevated parathyroid hormone, pancreatitis and stress. It plays a crucial role in cardiovascular disease. When in short supply, it is largely responsible for calcification of the arteries, blood clotting, elevated cholesterol, high blood pressure, tachycardia, heart attacks and strokes. Other diseases linked to low magnesium are: cancer (14), urolithiasis, kidney stones, arthritis (15), insomnia and menstrual cramps (16). Chronic Fatigue Syndrome patients have low levels of intracellular magnesium (17). In addition to having too little magnesium in the average diet (18), many factors reduce its absorption, such as lack of stomach acid.

Hair tissue mineral analysis has proven to be a reliable diagnostic tool (18). According to Dr Sherry Rogers, 40% of Americans are deficient in magnesium. She states that a blood test for this mineral is not reliable, but that a loading test is (19).

Foods high in magnesium are: green vegetables, kelp, soybeans, wheat germ, nuts, grains, seeds, cheese and eggs (5). Vegetables should be eaten raw, steamed or stir fried to prevent loss of this critically important mineral. To be on the safe side most adults would benefit from taking supplemental magnesium in a chelated form (20).

**Zinc (Zn) 47%**

Since its importance in human health was discovered a century ago, it has been found essential in the normal functioning of over 100 enzyme systems in the body. The highest level of this mineral in humans is in the eye and optic nerve (18) and the prostate gland in males (5). It is also found in the skin, adrenal glands, bones, brain, heart, kidneys, liver, muscles, spleen, and testes (18). It is of interest, that sperm count in young American males decreased significantly during the 20th century (22). It is necessary for carbohydrate metabolism and the synthesis of DNA (deoxyribonucleic acids). This helps control the synthesis of large complex protein molecules such as in enzymes and connective tissue. It helps the body reduce lactic acid from overworked muscles and assists in the transport of CO₂ (carbon dioxide) to the lungs.

Deficiency symptoms include failure to grow, loss of appetite, acne, slow healing, strong body or breath odor and a decrease in taste acuity. It is closely related to optimum blood circulation and cardiovascular disease. Intermittent claudication is due to impaired circulation in the lower limbs. It often results in severe limping and inability to walk significant distances. It may be relieved by taking zinc for a prolonged period (18). Animals deficient in zinc and copper formed plaques (fatty deposits) in their arteries. The relationship of zinc and copper to cardiovascular disease has been well covered by Dr. Klevay (23). These very important minerals are antagonistic. Low zinc is often associated with high copper. Pfeiffer reported that high copper is a nerve stimulant (24). Kumuru documented decreased zinc in the brains of schizophrenics (25). Excess zinc can interfere with copper absorption; taking them 8 hours apart is recommended. The level of zinc is very high in semen. Most men end up with prostate problems, including cancer.

Zinc absorption may be inhibited by excess sugar, insufficient hydrochloric acid (achlorhydria) and pancreatic enzymes. Severe food allergies may result in an inflamed gut and lessened zinc absorption. Heavy exercise increases the need for zinc (23). This mineral is required in the production of prostaglandin, especially the anti-inflammatory PGE-1 (26). The typical American diet is deficient in this mineral; one survey found 68% of adults consumed less than two thirds of the RDA (27). The milling of wheat results in an 80% loss of zinc (28).

Good sources of zinc are: beef, lamb, poultry, egg yolks, nuts, whole grains and legumes (5).

**Calcium (Ca) 46%**

Like concrete in buildings, calcium provides strength and rigidity to our skeletal structure. Bones and teeth constitute 99% of this mineral. The other 1% is so important that the parathyroid and calcitonin hormones plus the active metabolite of vitamin D regulates its level in the blood to within 3%. It does this by taking it from the bones and teeth (osteolysis) or excreting it.

Calcium is involved in the regulation of the heart beat, nerve transmission, muscle contraction and blood coagulation. It helps control blood acid–alkaline balance, plays a role in cell division, muscle growth and iron utilization. This extremely important mineral activates enzymes such as insulin and the thyroid hormone, calcitonin. It helps transport nutrients across cell membranes. It forms a substance that holds cells and tissues together. Normally, there is more calcium on the outside of cells (extracellular) and more magnesium on the inside (intracellular). When this ratio (resting potential) is disturbed, an electrical charge is produced. This is responsible for nerve excitation, which can be normalized by calcium (5).

This mineral produces messenger-carrying signals to control activities within cells through specific calcium channels. Calcium ions are required for activation of enzymes for normal blood clotting, cell division and insulin release (29).

When the body lacks calcium (hypocalcemia), many health conditions, such as osteoporosis occurs. This can result in the loss of teeth and cause spinal curvature. Other factors that exacerbate calcium deficiency...
are: excess synthetic vitamin D, too many stimulants such as coffee, hypoglycemia, excess alcohol, toxic minerals, diuretics, hypothyroidism and a chronic shortage of vitamin C. It should be noted that mineral absorption decreases with age. This is primarily due to insufficient stomach acid (achlorhydria) (30). Calcium deficiency increases the nerves’ resting potential which can trigger muscle contraction and cramps. Long-time deficiency often results in low back pain and sciatica. Such conditions may also be related to poor circulation (5). Common conditions related to excess calcium (hypercalcemia) are: excess thirst, mouth dryness, dysphagia, muscle aches, memory loss, tendinitis, depression, dyspepsia, conjunctivitis, joint swelling, fatigue, weakness, restless leg syndrome and constipation (30).

A blood test for calcium is not reliable; when the blood level of calcium falls below the critical level, it is taken from the bones and teeth (homeostasis) to maintain its critical level. The main reason for the increasing incidence of osteoporosis, is our relatively high intake of phosphorus. This comes primarily from animal products, processed food additives and soft drinks. Since calcium and magnesium work so closely, it is usually best to take them together.

Some good sources of calcium are: kelp, cheese, collard and turnip greens, nuts, sunflower seeds, buckwheat, milk and yogurt. In contrast to milk products, vegetables in general are best, since they have better mineral balances (5).

**Manganese (Mn) 40%**

Manganese deficiency at 40%, closely follows calcium. Its properties and importance have not received the attention they deserve. Most of the manganese (10–20 mg) is in the bones, liver and kidneys (32). It is an essential part of many important enzymes involved with energy production, bone and ligament formation, protein and fat metabolism. Manganese modulates neurotransmitter activity related to nerve-muscle disorders such as tardive dyskinesia (5). It, along with vitamin K is required for prothrombin, a protein necessary for blood clotting. Cholesterol, necessary for the production of hormones such as estrogen, requires manganese. A deficiency results in abnormal bone, cartilage and disk degeneration. Other manifestations include impaired glucose tolerance, birth defects, growth retardation, reduced fertility, brain function and inner-ear imbalance. A severe manganese deficiency produces epileptic seizures. A manganese deficiency lowers the threshold that causes seizures by reducing the neurotransmitter dopamine. A deficiency may also result in arrhythmia, weight and hair color loss.

Cancer cells, triggered by viruses and chemicals, had little or no manganese superoxide dismutase, the enzyme required to protect the nucleus and mitochondria from free radical superoxides. Dietary manganese deficiencies can exacerbate the toxic effects of soft tissue calcium, with implications for cardiovascular disease. It can be used more safely than calcium antagonists or blockers (5). When low it leads to glucose intolerance. It adversely affects the pancreas and insulin production so important in type 2 diabetics. At least half of the manganese in the typical diet is lost when whole grains are replaced by refined ones.

Best sources are: nuts, whole grains, turnip and other greens, carrots, broccoli and legumes (5).

**Selenium (Se) 40%**

This mineral is tied with manganese in deficiency rating. Its importance was first recognized in animal health, especially in areas of selenium poor soils (33). Its essentiality for humans was established as recently as 1957. It became well recognized as a result of the circulatory Keshan disease (cardiomyopathy) in China where some soils are especially deficient in selenium (34). To ensure that humans receive an adequate supply, the Chinese government now adds it to table salt in such areas (35).

There is convincing evidence of a negative correlation between selenium intake and the following: cancer of the breast, prostate, colon, pancreas, lung and bladder (36). This may be due to its powerful antioxidant ability to detoxify harmful toxic metals such as mercury and proliferating free radicals. One of the key elements of the enzyme glutathione peroxidase is selenium. It, along with vitamin E, appears to strengthen the immune system. The selenium-containing enzyme also plays a key role in preventing lipid peroxidation of the low-density lipoprotein (LDL). High LDL (when oxidized) promotes arterial obstruction (plaque), stroke, angina pectoris, and hypertensive kidney damage. Like manganese, it improves the performance of the energy-producing mitochondria. It does this by protecting the cells from insufficient oxygen. Selenium supplementation has been a helpful treatment in chest pains associated with angina (5).

A study in the U.S.A. found that cancer incidence was reduced by selenium supplementation (37). Foster questions why it has taken so long to ensure an adequate level of selenium to prevent this 20th century scourge. He believes it may be due to a fear that this mineral is toxic. It is when taken in excess; Greenland aboriginals ingest 600–700 mg daily with no evident ill effect (35). J. Wallach discovered that cystic fibrosis is strongly related to a deficiency of selenium (38).

Premature aging may be related to selenium-dependent glutathione peroxidase. Other health conditions in addition to cancer and the above are: Crohn’s disease, cataracts and macular degeneration, immune...
compete, and thyroid function (39). Benton and Cook of England believe that a deficiency of selenium is related to, ‘anxiety, depression and tiredness’ (40).

Good food sources of selenium are: soybeans, cereal grains, organ meats, seafood, garlic, onions, and yeast (5).

Potassium (K) 37%

Potassium represents only 5% of the body’s mineral content. It is a major cation in the intracellular fluid. Only a very small amount is necessary in the extracellular fluid. It works closely with sodium and chloride ions. It participates in normal water balance. It is easily absorbed and eliminated through the urine (38).

In the pre-agriculture era, potassium was quite abundant relative to sodium. As a consequence, the body developed mechanisms for regulating this critical mineral. The predominant Western diet, is the reverse, in that it is much higher in sodium than potassium. The kidney is the regulatory organ controlling this important balance. The potassium level in the cells remains fairly constant. When extra sodium enters the cell (low potassium), water enters the cell giving rise to edema (5).

Potassium is important in controlling the activity of the heart, muscles, nervous system and most cellular functions. When energy needs increase, the first reservoir is glycogen. This is stored in muscles and liver. It is made from glucose (blood sugar), and can be quickly converted back to glucose. The storage capacity of glycogen is limited. Once these reserves are filled, extra glucose is stored as fat. Conversion of fat back to glucose is slow and inefficient. Fat is a poor source of fuel for quick energy; it is insurance against extreme food shortages. Too little potassium means there is less glucose converted to glycogen. A high amount of glucose requires increased insulin. Low potassium diets produce great fatigue and muscle weakness. Extreme fatigue forces reduced activity, thus conserving potassium (5). In nerve cells, the electrical charge emanating from the sodium±potassium pump initiates a chain reaction of impulses that carry messages from cells to brain and back. In muscles, that action stimulates contractions which enable us to walk, talk and sustain a heart beat. In glands the charges set off the release of hormones, such as estrogen from the ovaries and testosterone from the gonads. The electrical pump created by sodium and potassium is like the power generator for activities within cells and organs (41).

Deficiencies of potassium are significant with certain diseases, severe burns and malnutrition. It can occur from the use of diuretics, aspirin, laxatives, diarrhea, diabetic acidosis, cortisone therapy, gastrointestinal disorder, cancer and adrenal tumors.

Symptoms of potassium deficiency are: irritability, edema, headaches, alkalosis, bone and joint pain and tachycardia. Increased sodium is related to hypertension; this tendency can be reversed by increasing potassium. When potassium levels are dangerously high, the result could be cardiac arrest. Kidney failure, dehydration and adrenal insufficiency can elevate potassium to toxic levels (5).

Quickly prepared processed foods have become very popular. In general such foods tend to be high in sodium and low in potassium. When vegetables are boiled in water, potassium is easily lost. Using that water in making soups and stews will save potassium. However an easy safe way, is to steam or stir fry such food. Vegetarian diets ensure more potassium; this has a bearing on their lower blood pressure than that of meat eaters. It is of interest that cancer specialists now are promoting at least four or five servings of fruit and vegetables daily. Unfortunately this advice is not being widely followed. In addition to being high in minerals, such as potassium, they are also rich in anti-oxidants (42).

Good sources of potassium are: fruits and vegetables, dulse, kelp, buckwheat, parsley, black molasses, Brewer’s yeast, rice bran, sunflower seeds, almonds, raisins, avocado, dried figs, dates, yam and halibut (5).

Iron (Fe) 25%

One quarter of those tested lacked iron. This is one mineral that has been recognized as essential since 500 B.C. Blood testing for iron has been used for a long time and still is. There is evidence that hair analysis can indicate a shortage or imbalance before serum changes can be detected (43). Iron absorption usually decreases with age due most likely to insufficient stomach acid and pancreatin (26). Excess sugar, white flour and fat, leads to iron deficiency. The iron added to enriched flour (inorganic) is not well absorbed (44). Dairy products such as milk and cheese can reduce its absorption by up to 60%, tannin in tea has similar effects (43).

There is a strongly held belief that one must eat meat to obtain sufficient iron. The Chinese on a vegetarian-type diet receive nearly twice as much as Americans who consume far more meat (45). Iron is necessary for the synthesis of DNA. It also activates enzymes involved in brain neurotransmitters (39). One of these is monoamine oxidase (MAO), which is reduced when iron is low. This leads to an increase in neurotransmitters such as nor-epinephrine, dopamine and serotonin (17,18). Iron and copper are closely related. The former cannot be utilized by the body without adequate copper (39).

Hemoglobin carries the oxygen to the cells. Iron is a small but vital component of hemoglobin in our 20 trillion red blood cells. Iron-containing enzymes are required for its transportation and ultimate utilization (5).
The human body contains only 3.5–4.5 g of this critically important mineral. There are two types; active (75%) and stored (25%). The iron-containing enzymes are: catalases, peroxidases and cytochromes. The stored iron, ferritin, and hemosiderin, are present in the liver, spleen and bone marrow. It is conserved by recycling (5).

Iron deficiency may result in fatigue, weakness, listlessness, poor appetite, pallor, headache, palpitation on exertion, infections, sore tongue, mouth inflammation, difficulty in swallowing, thin poorly formed fingernails, cold extremities, abnormal craving (pica) for such things as soil (5). It can lead to diarrhea, excess gas and stomach cramps (45). Iron supplements should be chelated; inorganic iron may result in constipation (5).

Toxicity symptoms include fatigue, loss of weight, headaches, shortness of breath and dizziness (5). Too much iron can also lead to aggressive behavior, hostility and hyperactivity (39). Alcohol is known to increase absorption and contribute to cirrhosis of the liver. It is related to neurological disorders, such as Parkinson’s disease. Too much iron damages tissues due to its effect of generating free radicals or lipid peroxidation (43).

Best sources of iron are: vegetables, legumes, meat, poultry, sunflower seeds, red wine and grains. Fruit aids in its absorption because of its vitamin C content (5).

Copper (Cu) 25%

It is of interest, that copper deficiency is on a par with its close partner – iron. With one quarter of those tested being deficient, it is a serious problem. Our number one health problem is related to the heart and circulatory system. Copper’s most critical function is directly related to the integrity of the cardiovascular system (5).

An average adult male contains only 75 mg of copper. It is present primarily in the liver, brain, heart, kidneys, pancreas, spleen, lungs, bones and muscles. It is required by more than a dozen enzymes such as superoxide dismutase (SOD). Rats fed a diet lacking in copper, had reduced bone mineral content and strength. It is a cofactor for the enzyme lysyl oxidase. This is required for the production of collagen and elastin, so important for strong flexible connective tissue. It is necessary for the oxidation of vitamin C which along with iron helps produce hemoglobin. A lack of copper could lead to an enlarged heart, weak blood vessels (aneurism) and elevated cholesterol (4). A copper deficiency may lead to iron accumulation in the joints, hence is related to rheumatoid arthritis, osteoporosis and arthritis. Minerals such as cadmium, lead and zinc are antagonistic to copper. A deficiency of this mineral may dispose one to candida, viral or bacterial infections (5). Klevay reported copper deficiency may contribute to ischemic heart disease, decreased HDL and increased LDL (23).

Dopamine levels are depressed when copper is deficient. A shortage may result in defects of myelation, related to multiple sclerosis (MS) and Parkinson’s disease. Other conditions commonly seen in patients with low copper are gout, hypothyroidism, hyperactivity and emotional disturbances (46). Vitamins that when too high, interfere with copper absorption are: B6, A, C, B3 and B5. Taking steroids also results in a loss of copper. Minerals which favor copper absorption are calcium, cobalt, selenium, sodium and iron. In contrast, zinc and molybdenum are antagonistic. Observations by the author showed that copper deficiencies were lower in Central Canada, compared to the West Coast. When soils are acidic, copper absorption by plants is increased. Low pH soils are more common in the eastern half of the continent and the far west where rainfall is high. Copper toxicity is quite common in the U.S.A. and to a lesser extent in Canada. Both surface and ground water, may contain this mineral. The situation is exacerbated when the water is acidic and the piping is copper. It enters the food chain through its addition to animal feed and when used as a pesticide. Patients with high copper levels often have a variety of symptoms such as fatigue, nervousness, depression, irritability, muscle and joint pain, tiredness, behavior problems, learning disabilities and mental diseases. Oral contraceptives and copper uterine devices usually result in elevated copper. Increased copper accumulation often develops as a result of a viral infection, such as mononucleosis and hepatitis. It has been found that premature aging (wrinkling) of the skin is related to excess copper. It may be due to a release of free radicals, which oxidize fats (lipid peroxidation). This can lead to stiffening of tissues (leathery skin) and blood vessels that leak or break open (5). Several medications such as Thorazine may result in copper toxicity.

Often more consideration is given to its toxicity than deficiency; the normal range is somewhat narrow. It is a very important mineral especially since it is required for critical enzyme systems. The validity of hair mineral analysis for copper status has been well established (46).

Good sources of copper are: buckwheat, oysters, liver, molasses, soybeans, dried legumes, wheat germ, mushrooms and yeast (5).

Molybdenum (Mo) 15%

Molybdenum is a key component in important enzymes required for fat oxidation and purine metabolism (47). The average adult contains only 9 mg, concentrated mainly in liver, kidney, adrenal glands, bones, teeth and skin. Deficiencies are due primarily to its loss in the refining of food, such as wheat to white flour. To a minor extent, it is lacking in some soils (5).
It was discovered some years ago that in an area in China, where soil molybdenum was very low, there was a high rate of esophageal cancer (5). Scientists in New Zealand discovered low molybdenum increases dental caries (48). This author taught navigation to airmen in World War II. He was surprised to learn that most of these otherwise healthy young airmen from that country, were denture dependent. In contrast, there was a very low incidence of tooth decay among U.S. Navy recruits from Ohio (5). A lack of this mineral is associated with sexual infertility (4). Molybdenum and copper appear to interact, share or compete for common enzyme systems. More work is needed to study possible relationships with other nutrients (5). Excess molybdenum can interfere with copper metabolism (46).

Good sources of molybdenum are: buckwheat, oysters, liver, molasses, soybeans, dried legumes, wheat germ, mushrooms and yeast (5).

Phosphorus (P) 9%

Phosphorus deficiency at less than one in 10, is an indication that it is not a serious problem. In fact, too much of this mineral is responsible for many health problems. It is an essential part of our bones and teeth. In addition, it is necessary for the important enzymes, mono, di and tri adenosine phosphate such as ATP. These enzymes store and release energy for bodily functions. Nucleo proteins are the major components in the nuclei that control cell division, reproduction and heredity. Fats require phosphorus to produce necessary phospholipids, such as lecithin. It combines with B vitamins such as B3 (niacin) to form nicotinic adenine dinucleotide (NAD). This is essential for good digestion and emotional health (4).

Excess phosphorus combines with minerals, forming insoluble salts in the intestines and urinary tract. When these are excreted important bone minerals, especially calcium, are lost. This contributes to degenerative diseases such as kidney damage and osteoporosis (4). Dr. Mildred Seelig stated that between 1940 and 1980 we almost doubled our daily intake of phosphorus from 800 mg to 1400 mg. The situation since then has not likely improved (49).

A high protein-phosphorus-containing diet increases urea which is a diuretic. When urea enters the kidneys the result is a loss of water along with essential minerals. Proteins break down to amino acids, which are absorbed into the bloodstream. This creates excess acidity which is neutralized by calcium. This precious mineral is removed from bones and teeth (osteolysis). Ideally the ratio of Ca : P should be 1 : 1 but it is closer to 1.5 : 1. The culprit in all this is our high meat-based diet. Soft drinks and food additives also contribute to a surplus of phosphorus (4). It is of interest, that we consume twice as much calcium as the Chinese, but their diet contains much less phosphorus. Most of their protein comes from plant foods (45). From the author’s observation, vegetarians or semi-vegetarians have a better Ca : P balance. They tend to have fewer health problems than those who concentrate on animal products.

The best sources of phosphorus are fish, meats, poultry, eggs, legumes, milk and milk products, nuts and whole grain cereals (4).

Sodium (Na) 6%

It should not be surprising, that so few tested low in sodium. Salt craving has been recorded in both man and animals since ancient times. Most of our supply comes from sodium chloride (NaCl) or table salt.

The chloride ion which is part of table salt is essential for the production of hydrochloric acid (HCl) in the stomach. Kidneys regulate the electrolytes. If sodium is low, they prevent its loss. If it is too high, it promotes excretion via the urine (18).

Both sodium and potassium are present in blood, lymph, muscles, nerves and in the formation of saliva and digestive enzymes. Health problems from too little sodium seldom occur. Table salt is used to enhance food flavor and as a preservative. Natural foods such as vegetables tend to be high in potassium and low in sodium. The reverse is true for processed foods. Excess sodium retention increases fluid volume which results in edema. Low sodium is related to dehydration. If sodium intake is high, the adrenal cortex hormone aldosterone decreases in the blood and the kidneys excrete more. Kidney patients have problems maintaining optimum sodium levels. In hot climates sodium must be replaced due to its loss from sweat, if not, it can result in dizziness, cramps, exhaustion, apathy and circulation failure (5).

Good sources of sodium are kelp, sauerkraut, cheddar cheese, leafy green vegetables, sesame seeds, yogurt, lentils and sunflower seeds (47).

Foods contributing to excess sodium are: processed meats and fish, baked goods, crackers, pasteurized cheeses, French fries, pickles, peanut butter, potato chips and softened drinking water (5).

Toxic metals

The use of hair analysis for measuring toxic metals commenced in the 1970s. It has been more widely used and accepted than for essential minerals. In 1984, Dr. J. Wright stated, ‘the consensus of opinion appears to be that hair levels of toxic metals are the best single indicator of long-term exposure, considerably better than blood or urine’ (26). Table 2 indicates the percentage of those tested that had excessive levels of toxic metals.
Aluminum (Al) 9.4%

Aluminum is a toxic metal which stores in the lungs, liver, thyroid and brain (45). It binds with phosphorus, making it unavailable. There is a significant association between it and Alzheimer's disease. This disease was quite rare when discovered in 1907, it is now considered the fourth leading cause of death. High levels of aluminum found in the brains of victims, interfere with choline transport. This results in a deficiency of acetylcholine, a characteristic of this disorder (50). Autopsied brains of those dying of this disease have unusually high levels of aluminum along with neurofibrillary tangles (51). The rapid development of Alzheimer's disease during the 20th century coincides with the availability and widespread use of this metal. People on dialysis accumulate high amounts of aluminum. An excess of aluminum can contribute to a deterioration of mental function and bone density. As well, it can inhibit important enzyme systems (18).

Whether or not we absorb aluminum instead of excreting it, depends largely on our diet. Typically, we favor acid-forming foods over alkaline ones. An animal-based diet, high in phosphorus creates low calcium and concomitant hyperthyroidism. This results in increased absorption of aluminum — a vicious cycle. Virtually all those tested who had high aluminum, were also low in essential minerals, especially calcium and magnesium. When they took steps to avoid aluminum ingestion and increased their essential minerals, it was reduced to a safe level in a few months. Excess aluminum can also bind phosphate in the GI tract, which can cause problems, such as aching muscles, rickets and osteoporosis (51).

Aluminum is often used as a buffering agent in medications and is found in some herbs. It is absorbed in the following ways: aluminum cookware especially when used with acid-foods, coffee makers, aluminum foil, beer and soft drink cans, and liners for soft drink containers, some tap water, anti-perspirants, vaginal douches, fabric softeners, most baking powder, some table salt, many antacids (such as Mylanta), buffered aspirin, tea, some pickles, bleached flour, some processed cheese, pancake and cake mixes, non-dairy creamers, cigarette filters, nasal sprays, food coloring and Kaopectate (51).

Lead (Pb) 3%

Such a small number (3%) in this study that tested high in lead indicates that it is now only a minor threat to good health. This has not always been the case. The Romans stored their wine in lead vats; some attribute the fall of their empire to lead poisoning. Since industrialization, it has been widely mined and used. Prior to the knowledge of its potential danger it was often used in water pipes, paint and as an anti-knock additive in gasoline. Hair analysis is generally recognized world-wide, as an accurate tool to measure occult lead toxicity. Its use in paint was banned in 1971 and more recently from gasoline.

Lead mostly affects the nerves through interference with energy production and the release of neurotransmitters. Acute lead toxicity leads to encephalopathy. Chronic lead exposure may result in learning disability, especially with children. The potential danger from lead will continue to be a problem. It remains indefinitely in polluted soil.

Other sources of lead are: drinking water from leaded or soldered copper pipes, organ meat, painted glassware and pottery, newsprint, putty, car batteries, tobacco, lead shot and mascara. Some hair treatments contain lead (4).

Cadmium (Cd) 0.8%

Excess cadmium occurred in less than one percent (0.8) of those tested. It is believed to be the most toxic metal, especially if inhaled with tobacco smoke. Those who live with heavy smokers are almost as much at risk as the perpetrators. It is strongly related to hypertension, kidney and liver damage, emphysema, chronic bronchitis, cancer and anemia. Adequate levels of essential minerals (especially zinc) and vitamin C reduces its absorption and excretion.

Major sources in addition to tobacco are highly processed foods, pesticides, soft drinks, soft water, galvanized pipes and solder joints in copper plumbing (4).

Arsenic (As) 0.3%

At much less than one percent (0.3) with elevated arsenic, it appears not to be a serious problem in Western Canada. It played a role in treating various ailments since ancient times. It was suspected that Napoleon was poisoned by arsenic, since it was high in his hair (18).

Arsenic quickly leaves the blood to be deposited in the vital organs. Earlier in this century, it was widely used in medicines and pest control. During the 1950s, its use in agriculture was curtailed when more effective organic compounds were introduced.

Arsenic adversely affects the brain, skin, hair and nails and can cause cancer. Symptoms of toxicity are fatigue, loss of the sense of pain and gastroenteritis. It depletes the body of phosphorus and may result in heart abnormalities. Relatively small amounts have always been consumed through the food chain from leaching of rocks and soil. We add to that when we burn wood, coal and oil (4).

Mercury (Hg) 0.1%

An excess of mercury occurred in only one in a thousand clients. The rate calculated by the author 10 years ago was
earlier times, it was believed that the mind operated in integral and crucial part of the whole person. It might be relative isolation. It is now generally accepted, that it is an related condition shown in Table 3, was depression. In complex mechanism of the computer. Similarly, the brain compared to the mouse which is used to control the

The fillings; the pressure of chewing promotes the production of methyl mercury. Both the current and methyl mercury can be measured. When the readings indicate a possible problem, amalgams are removed sequentially and replaced by non-toxic composite materials. Countries such as Sweden banned its use. FDA removed its approval in 1991. When amalgams are removed and replaced with non-toxic materials improvements have been reported by Huggins and others. There is an alleviation of mercury poisoning is a more recent phenomenon. A factory in the Minamata region of Japan dumped large amounts of waste mercury into the bay. It was changed by living organisms to the much more toxic methyl mercury. Tragedy struck when 46 people died. Babies were born defective and many suffered as a result of eating the contaminated fish (5). It also comes from: some insecticides, mercury treatment of seeds, cosmetics, fabric softeners, fungicides, mercurochrome, calomel, hemorrhoid suppository preparations and sewage sludge.

There continues to be a controversy over possible harmful side effect from mercury amalgams. Excessive mercury in the body can harm the liver, kidneys, pancreas, bone marrow as well as aggravating hypertension and diabetes. Dr Hal Huggins, a dentist in Colorado has been a persistent spokesman for ending the use of dental amalgams. They consist of a mixture of mercury (about 50%), silver, tin and zinc. Two or more positively charged minerals in close proximity, and in the presence of saliva, produce galvanic currents. This can cause a breakdown of the fillings; the pressure of chewing promotes the production of methyl mercury. Both the current and methyl mercury can be measured. When the readings indicate a possible problem, amalgams are removed sequentially and replaced by non-toxic composite materials. Countries such as Sweden banned its use. FDA removed its approval in 1991. When amalgams are removed and replaced with non-toxic materials improvements have been reported by Huggins and others. There is an alleviation of neurological, cardiovascular, immunological conditions and allergies (4).

**HEALTH CONDITIONS SURVEY**

It should not be surprising, that the most reported health related condition shown in Table 3, was depression. In earlier times, it was believed that the mind operated in relative isolation. It is now generally accepted, that it is an integral and crucial part of the whole person. It might be compared to the mouse which is used to control the complex mechanism of the computer. Similarly, the brain is inextricably connected to every part of the body's nervous system. If it is lacking in nutrients, such as the essential mineral selenium, or harmed by toxic ones, it will negatively impact on our mind and emotions. One of the pioneer medical researcher to recognize this relationship, was Dr Abram Hoffer. He was the first psychiatrist to see the need for nutrient supplementation (52). Low calcium can result in depression, anxiety, panic attacks, paranoid feelings, headaches and insomnia (18).

Close to a third of the sample, had allergies. This is often related to the leaky gut syndrome which allows allergens into the blood. The over use of antibiotics, destroys the ‘good’ bacteria which exacerbates this problem (53).

Low back pain and related arthritis affected almost a quarter of those tested. Mineral imbalances and lack of calcium and magnesium especially, are closely related to these problems (4).

Cardiovascular diseases were reported in 16% of those tested. Chromium, the most deficient mineral, is closely associated with the development of heart disease, our number one cause of death. Low chromium is associated with elevated cholesterol and plaque formation. Adequate chromium results in an increase of high-density lipoprotein (HDL), the ‘good’ cholesterol. Chromium improves insulin utilization and decreases its requirements (18).

Poor digestion was reported by 14% of those sampled. It is now generally accepted that the excessive consumption of simple carbohydrates with high glycemic indexes, greatly contribute to this condition (54). A lack of stomach acid (achlorhydria) and pancreatic enzymes, is related to this condition. It usually happens as one ages (55).

**MISCELLANEOUS INFORMATION**

Table 4 includes some statistics, of general interest. An earlier report (4) consisted of Central Canada clients from 1974 to 1985. The one done since then, was mainly West Coast Canadians.

Most (70%) were on a supplement program and about half (44%) were taking prescribed medication. Only 28% were on a very nutritious diet; the average age was 49 years. The female clients outnumbered the male (58% versus 42%), indicating greater concern over their health. Most members of the sample had one or more health condition. Only a few came as a result of a doctor’s referral. This is an admiral example of self help, which represents a

<table>
<thead>
<tr>
<th>No.</th>
<th>Condition</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Depression</td>
<td>31</td>
</tr>
<tr>
<td>2</td>
<td>Allergies</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Low back pain</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>Arthritis</td>
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<td>5</td>
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<td>16</td>
</tr>
<tr>
<td>6</td>
<td>Digestion</td>
<td>14</td>
</tr>
</tbody>
</table>
positive paradigm shift. This change began in earnest in the early 1990s. Prior to that time, most doctors believed that a ‘good diet’ would provide all required nutrients, supplement use was not generally recommended. The concept of supplementation got a big boost when *Time*, *Newsweek*, and similar well respected publications ran favorable stories in that time period.

The former Mineralab (now AMNI and recently Douglas), at Hayward, California was one of the pioneer laboratories doing hair mineral analyses. Garry Gordon, M.D., was the medical director of this lab. He reported on some of his findings prior to 1983. He found that the average percentage of those with an excess of toxic minerals was 61% (56). The author’s results (Central Canada) at the same period were a lower 40% (4). Gordon also reported on a study done at that time on a sample of 50, from the primitive mountainous village of Villacabamba in Ecuador. The level of toxic minerals in that remote non-industrialized place, was a mere 5% (57).

The toxic mineral levels (13.6%) in this report compared with a 1983 one (40%) indicate a very significant improvement (4). Since the 1980s, the governments of the U.S.A. and Canada have banned the use of lead in gasoline and in household paints. The use and acceptance of hair analysis for assessing toxic minerals has increased, worldwide. Positive steps are taking place to eliminate them through IV and oral EDTA chelation. People are now more aware of the dangers and are avoiding them.

**HYPOTHESIS**

When the diet of humans from conception on is lacking in one or more essential mineral or has an excess of toxic ones, the result is a feeling of uneasiness. Infants will usually respond by crying, when mothers usually give them milk. Young people or adults in a similar situation will often turn to pleasurable sugar-laden food or drink. Sugar consumption results in the pancreas production of insulin and the neurotransmitter serotonin. When such individuals production are consuming a nutrition-poor diet, this negative pattern escalates. From sugar, other more potent crutches probably would be soft drinks, tea, coffee, beer, wine, strong alcohol and ultimately addictive harmful drugs. The final results of such a poor lifestyle inevitably leads to ever increasing bad behavior and often criminal activities necessary for obtaining such expensive drugs. Other common health conditions following an inadequate diet and poor lifestyle found in order of frequency in this study were: allergies, low back pain, arthritis, cardiovascular disease and poor digestion. We need to ask ourselves why? It is the author’s contention that most of our poor mental and physical health is the result of three predominant factors. The first is the adverse effects of diets lacking in essential minerals. The second is the harm from toxic minerals coming from our food and environment. The third is the harmful effects from careless industrialization which has polluted the air, soil and water.

**CONCLUSIONS**

The results as indicated in this paper are not at all reassuring. Granted, people are living a little longer, but the quality of life especially for the aged, is deteriorating when compared to a century ago. The health of humans in the industrialized world will not likely improve until significant changes are made to their diet and lifestyle.

Dr Patrick Quillin in Table 5, illustrates why we are overfed and undernourished (57). These items bring transitory pleasure, but at a high cost healthwise. The powerful food giants have done a superb job in promoting and selling such items. The public has been poorly advised in foods such as dietary fats. Forty years ago, we were told that the consumption of animal (saturated) fat was harmful and should be greatly reduced. As a result, butter and lard consumption decreased significantly. During this period, the use of refined harmful vegetable oils and margarine (trans fat) increased greatly. Recent trends promote ‘low fat’ foods, but unfortunately, fat is often replaced by more harmful sugar. These foods usually lack essential minerals that plants, animals and people must have to be healthy.

**REFERENCES**