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Newsletter

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IMPLICATIONS OF LEAD TOXICITY

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INTRODUCTION

The most prevalent of the toxic metals in our environment today is lead. According to the National Academy of Sciences, approximately 600,000 tons of lead is added to the atmosphere each year. The National Health and Nutrition Examination Survey estimates that 1.9 percent of the United States population has blood levels that exceed acceptable limits; of the black population alone, more that 18 percent exceeds normal limits. In addition, four percent of the children ranging in ages from 6 months to 5 years, or over three quarters of a million children, exceed safe blood levels. Since lead is known to be cumulative, contributing to a variety of neurological disorders and ailments, it is recognized as the most dangerous of the toxic metals, and a major threat to the biological systems of both humans and animals.

Sources of lead contamination

Lead is naturally contained in the earth's crust and increases as radioactive materials degrade. Atmospheric lead, however, has largely been contributed to by the use of leaded gasoline. Since 1974, regulations enforced by the Environmental Protection Agency, have reduced the amount of lead in gasoline by over 50 percent. However, over 500,000 tons per year are still being used in motor vehicles today.

Another source of lead contamination is lead based paint. Even though lead based interior house paint is no longer in use, the lead paint which was used on older homes is still a major source of contamination. A survey has shown that approximately one-third of the family dwellings in the United States were built before 1940, and during this time lead paint was used extensively. Over one-half of our present housing was built before 1960. Lead based paint may have been used in the majority of these homes, since legislation was not enacted until 1971 that limited the use of leaded paint. Although lead based paint has not been used extensively since that time, its prior use is still posing health hazards. Leaded dust produced from renovating old homes or tearing down old buildings has increased the soil concentration of lead to extremely high levels. This, along with auto emission may account for the higher lead burden of children living in large cities.

Due to the excessive amount of lead in our environment, it is no surprise to find food as another source of lead. Children who experience pica may ingest lead from paint chips, dirt, and newsprint, as well as canned foods. Acidic foods that are stored in metal containers can leach lead from the solder which is used to seal the cans. This includes such items as canned baby foods, juices and evaporated milk. The only food which has an acceptable lead level established by the Food and Drug Administration is evaporated milk, which may contain up to 0.3 parts per million.

Water can also be a source of lead. Although new buildings and developments are now using plastic or concrete for their water source, homes and buildings found in older cities may still be using the original lead mains.

An individual can also be exposed to lead through cosmetics, pesticides, metal polish, and industrial sources, such as smelters, glass production, battery manufacturing, and electroplating.

It is estimated that the daily amount of lead received from food and air sources today can total 50 to 900 micrograms per day. This is almost 1 milligram per day for individuals living in areas with high lead concentrations.

Population groups most susceptible to lead

The entire U.S. population is exposed to lead via atmospheric (inhaled) or food (ingested) sources. Tissue mineral studies of the hair have revealed at least trace amounts of lead in all the individuals tested.

Cheraskin and Ringsdorff reported significant findings in the ***Journal of Orthomolecular Psychiatry,*** from tissue mineral hair tests of over 34,000 subjects. They revealed that the highest percentage of elevated lead levels were found in the 0 - 4 year age group. Lead concentrations then decreased in the hair of young adults, and eventually increased again in the elderly. In every age group, higher levels were found in males rather than females. These same findings have also been reported by other investigators studying blood levels of lead in large population groups. Higher levels are found in urban and low-income groups, and as previously stated, with a significantly higher incidence in the black population.

Retention rates

Normally, 1 to 10 percent of the ingested lead is absorbed into the body, and approximately 30 to 50 percent of inhaled sources, depending upon the form. Studies have shown that a much higher rate of absorption occurs in children. Children can absorb as much as 50 percent of the amount ingested, which may account for the rise in learning disabilities and behavioral disturbances in children of the United States.

Effects of lead on the biological system

Organs affected by lead toxicity are the kidneys, liver and pancreas. The brain, nervous system, bone marrow, immune system and collagen synthesis are also adversely affected by excess lead concentrations. Lead will also decrease some ATPases and enzymes necessary for normal cellular oxidation.

It is well-known that lead interferes with almost all the enzyme steps involved with heme synthesis. The most significant of these enzymes include aminolevulinic acid synthetase, aminolevulinic acid dehydratase and ferrochelatase.

Physiological and psychological symptoms associated with excessive lead burden

Early signs of lead accumulation may be vague and include symptoms such as fatigue, anemia, abdominal discomfort, vertigo, headaches, joint pains, ataxia, tremors, poor coordination, and memory impairment.

Moderate levels of lead can contribute to suppression of the immune system, nephrosis, cancer, stillbirths, dental decay, arthritis, and hypertension.

The effects of lead on the nervous system have implicated it as a major contributor to hyperactivity, learning disabilities, behavioral disturbances, schizophrenia, autism, attention deficit disorders, depression and neurological diseases such as Parkinson's syndrome and Multiple Sclerosis. Recent reports have indicated that the Sudden Infant Death Syndrome (SIDS) may also be contributed to by excess lead absorption in infants. It was found that the increased incidence of SIDS followed increased air levels of lead by one to two months. Tissue studies of infants who died of SIDS revealed higher lead concentrations than those who died of other causes.

Nutrients in relationship to lead

Due to the fact that not everyone absorbs the same amount of lead, even with equal exposure, leads us to believe that a predisposition may account for these differences.

Iron: It is well-known that lead interferes with iron metabolism and contributes to various forms of anemia. Lead and iron also compete for intestinal absorption. In lieu of iron deficiency, lead absorption can be greatly increased.

Zinc: Since lead adversely affects zinc metabolism, a zinc deficiency may also contribute to increased body burdens of lead.

Calcium: Calcium inhibits the absorption of lead as well as prevents its deposition into the bones and teeth. In lieu of calcium deficiency, lead will deposit in the bones and teeth similar to calcium. This may account for the higher dentine level of lead in children with a high incidence of cavities.

Thousands of hair mineral studies of children have revealed that most children in the 0 - 4 year age group have low tissue levels of calcium and magnesium. This may account for the increased lead burden found in the tissues of this age group and why it makes them more susceptible to the retention of lead.

Vitamin D: Research has shown that vitamin D increases the intestinal absorption of lead. This may account for increased lead levels in children during the summer months, due to the sunlight increasing the synthesis of this vitamin. Lead induce hyperactivity may also increase during summer months.

Protein: Low protein intake is associated with increased lead absorption. Poor diet may contribute to increased lead burdens in the low-income groups showing higher lead burdens.

Other nutrients such as the minerals magnesium, copper, chromium, vitamin C and the B vitamins have been shown to protect against the effects of lead as will, either by decreasing its absorption and tissue deposition, or by reducing or blocking the effects of lead upon enzyme systems.

Testing for lead contamination

Almost all of the lead circulating in the blood is found within the erythrocytes. A clinical characteristic of lead toxicity or plumbism is, basophilic stippling of red blood cells. The upper limit for whole blood levels of lead is 30 micrograms per deciliter. This level is controversial at present, due to findings that levels well below these limits altered the central nervous system function in children.

If the kidneys are being affected by excess lead accumulation, aminoaciduria, phosphaturia and glucose uria may be found. Reduced plasma levels of 1,25-dihydroxycholecalciferol may also be found.

Since lead interferes with heme synthesis enzymes, elevated urinary excretion of protoporphyrin may be elevated in the red cells.

Hair Tissue Mineral Analysis

Since lead normally departs from the blood for deposition into such tissues as the bones, teeth, and hair, hair mineral testing can be an accurate screening tool for toxic metal accumulation. It is also economical, and an easily obtainable tissue.

Hair has been used as one of the tissues of choice by the Environmental Protection Agency in determining toxic metal exposure. A 1980 report released by the E.P.A. stated that human hair could be effectively used for biological monitoring of toxic metals. This report confirmed the findings of other studies, which concluded that hair might be a more appropriate tissue for studying community exposure to toxic metals than blood or urine analysis. Investigators in Japan, Sweden, Canada, and the United States have shown that the concentrations of elements in the hair provide an accurate and permanent record of exposure.

Removal of lead from the body

Ethylenediaminetetraacetic acid (EDTA) is frequently used for more severe cases of lead poisoning. Penicillamine and British anti-lewisite (BAL) are also considered therapeutic agents for acute lead toxicity.

Evidence now shows that even low lead levels can adversely affect neurological function. Since poor diet has been related to higher lead accumulation, it is possible that therapeutic nutritional application can relieve low lead toxicity and the disorders that accompany.

Alginate and pectin have been noted to decrease the absorption of ingested lead. Calcium, magnesium, zinc, copper, and iron not only help protect from the absorption of lead, but also can hasten its removal when properly used.

Ideal lead nutrient ratios

Trace Elements, Inc. has established the upper "acceptable" limit for tissue lead at 0.5 milligrams percent (mg.%) or 5 parts per million (PPM). Since evidence of lead toxicity exists well below the levels recognized as significant, the lead level in relation to other mineral levels should be considered more important for diagnosis, rather than the tissue lead level alone. If any of the following ratios are below normal, it can be assumed that lead may be interfering with that mineral's participation in enzyme functions.

Even though the results of tissue lead concentrations for both groups were considered insignificant, ... nutrient ratio evaluations show that lead may be a significant factor in the autistic group.

HAIR TISSUE MINERAL ANALYSIS

Ideal Nutrient Levels	*Ideal Minimum Lead Ratios*
Ca.........42 mg.%	*Ca/Pb............84 to 1*
Mg..........6 mg.%	*Mg/Pb............12 to 1*
Cu.........2.5 mg.%	*Cu/Pb..............5 to 1*
Zn..........20 mg.%	*Zn/Pb.............40 to 1*
Fe.........2.8 mg.%	*Fe/Pb.............5.6 to 1*

Evaluation of data reported by Marlowe, Cossairt, Stellern, and Errera in the *Journal of Orthomolecular Psychiatry* revealed significant nutrient mineral to lead ratios of 28 autistic children as compared to 18 control subjects. Even though the results of tissue lead concentrations for both groups were considered insignificant, 6.28 ± 2.12 ppm (0.62± 0.21 mg.%) for the autistic group and 6.66 ± 2.49 ppm (0.66 ± 0.24 mg.%) for the control, nutrient ratio evaluations show that lead may be a significant factor in the autistic group.

The Ca/Pb ratio in the autistic group averaged 38 to 1 compared to the controls, which averaged 158 to 1 (T.E.I. minimum ideal is 84 to 1). Mg/Pb ratios averaged 3.3 to 1 in the autistic group and 11 to 1 in the controls, (T.E.I. minimum ideal is 12 to 1).

Therapy

Supplementation of individual minerals would be indicated if lower than normal ratios are present. Appropriate vitamins should also be used in conjunction with dietary changes that would further help decrease the body burden of lead.

Removal of any form of ingestible lead is imperative if any nutrient mineral ratio is lower than ideal. Avoid any canned foods sealed with solder, or acidic foods stored in earthenware containers. Check to see if lead water pipes are being used. If lead water pipes are used, either filter the water, or change to bottled water. Avoid foods grown near highways, if possible.

Further prevention of airborne lead would consist of not jogging near heavily traveled roads. Opening the windows throughout the home at least once per week would be suggested in order to decrease concentrations of lead accumulating inside well-insulated buildings.

Conclusion

Toxic lead is recognized as the most hazardous of all the toxic metals. Children, the elderly, and pregnant women are the most susceptible to the effects of lead, i.e. absorption and retention. Since even low levels of lead can affect the fetus and contribute to learning disorders, behavioral disorders, emotional and physical health problems, routine screening of patients presenting these symptoms may uncover low level lead toxicity.