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CHILDHOOD BEHAVIORAL PROBLEMS

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Abstract

The author has spent approximately six months of each of three consecutive years searching for etiologic factors at the Genessee Intermediate School District Center for Autism in Flint, Michigan. The investigation has involved physical examinations of all of the children. Hair analysis and blood electrophoretic studies have been done on a large proportion of the group under study. The effects of various therapeutic modalities and of changes in the physical environment upon behavior are reported in overview. In this article the results of the analysis for the mineral content of hair for a sample of forty-one children are reviewed in depth.

Introduction

Abnormalities of body mineral content have been ignored by most physicians for many years. These abnormalities must, however, be considered as potential causes for behavioral disorders. If one has successfully treated a few cases of behavioral disorders by correcting mineral imbalance, or by ridding a child of an accumulation of toxic minerals in his body, he is set up to blame all similar behavioral problems on mineral content.

An example of this type of error is on file. A 16-year old boy, who had been diagnosed as "autistic" about ten years earlier, had been treated as such since that time and was considered virtually hopeless. He did not speak a language with which we were familiar, although he responded to hearing his name. He gave little or no eye contact. He was resistant to behavior modification techniques, which had been attempted for two years. He chewed his lower lip and left wrist almost constantly so that both areas were very macerated and raw. He was prone to sudden outbursts of anger and violence, having broken windows and furniture. More seriously, he had inflicted bodily harm on several other students in the special school which he attended, as well as injuring one teacher and the principal, all within the one year prior to our encounter with him.

A complete physical examination revealed no gross visceral abnormalities and no gross neurological deficits. It did reveal some restriction to joint mobility and some swelling of a few of his extremity joints. The spinal mobility of the upper thorax was very limited.

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A good rapport was established with him by the use of gentle touch with applied manipulative techniques to relax the tissues and mobilize the upper thoracic vertebrae. He appeared to be in pain, which seemed to be relieved by these techniques. His craniosacral system mobility was sluggish but did not suggest severe osseous or membranous restriction.

Serum protein level suggested an inflammatory process; the alpha 1, alpha 2, and beta fractions being elevated as shown in the blood electrophoresis studies. He exhibited a mild depression of the liver fraction of the LDH isoenzyme. Lipid panel, alkaline phosphatase, CPK isoenzymes, and T3, T4, and TSH were all within normal limits. The inflammatory process could easily be accounted for by the self-inflicted destruction of the tissues of the lip and left wrist. Hair analysis revealed rather marked elevations of magnesium, sodium, and potassium. Elevated sodium often accompanies heavy metal toxicity. His aluminum level was elevated to 4.1 mg%; the acceptable norm for aluminum is 0.2 to 1 mg%. Aluminum toxicity was considered as the probable etiology in this patient since it is known that aluminum accumulates in brain tissue and will, indeed, affect its function.

Serum blood tests also included those for sugar, urea nitrogen, uric acid, calcium, and inorganic phosphorus. Results showed normal levels except for uric acid, which was elevated to 12.4 mg%. This elevation of blood uric acid suggested that a Lesch-Nyhan Syndrome should be investigated: chromosome studies confirmed the diagnosis. Lesch-Nyhan, a genetic disease carried by the female, presents the clinical syndrome in the male[7]: this boy has a sister entering childbearing years for whom proper genetic counseling was obtained because of the possibility of effect on potential male offspring. This case points up the error which could have occurred had the examiner continued to accept aluminum toxicity as an etiologic agent for the boy's problems.

Since 1975, brain dysfunctions of various kinds were studied. The work has included three 6-month sessions (two days per week) at the Genessee Intermediate School District Center for Autism in Flint, Michigan. The clinic at Michigan State University includes the establishment of the Genesis Foundation in both the United States and Great Britain. In the United States Genesis is a fund raising foundation providing financial support to research, while in Great Britain it is an organization which provides holistic treatment for brain dysfunction in children.

The total sample includes a very wide variety of brain dysfunctioning children: childhood psychotics, so-called autistics, cerebral palsied, severely mentally impaired, Down's syndromes, dyslexics, hyperkinetics, emotionally impaired, seizure disordered, and children suffering from various levels and kinds of abuse, neglect, and deprivations. Also seen and quite successfully treated are problems as simple as uncomplicated strabismus by the use of craniosacral manipulative techniques.

Experience strongly suggests that each child must be considered individually: diagnostic labeling often hinders this process. One must try to avoid formulating negative expectations and subsequent placement of the child in a position of fulfilling these negative expectations.

Each behaviorally dysfunctioning child is the result of complex contributing factors, including the physical, emotional, sociological, genetic, biochemical, and nutritional. It seems impossible to study each child in depth in all of these areas; therefore the physician must try to keep all of these contributing etiologic categories in mind while gaining an impression both of the child and his family: physical and historical information are of utmost importance.

Experience also provides clues which point the open-minded physician or therapist in correct general directions which lead to specific areas for in-depth study.

Self-inflicted pain may be a clue that uncontrolled pain is always present. The pain which is self-inflicted is under the child's control and probably stimulates endorphin production by the child's own brain, thus providing relief from the uncontrollable pain and, perhaps, even some level of euphoria. Endogenously produced endorphins may be addicting.[29] One may be dealing with narcotic addiction with the "drug supplier" being the child's own body.

Eczema, skin rash, and some retardation of growth may be the clue which suggests zinc deficiency.[6] In addition to mineral studies, the following guidelines should be taken into consideration by the examining physicians for accurate diagnosis:

1) Does motor coordination dysfunction exist? (This has been found to be due to craniosacral system dysfunction on numerous occasions.)[25]

2) Is there responsiveness to you?
(It may be very subtle and secretive; you must watch very closely.)

3) Are there abnormal odors about the child?
(Metabolic disorders have their own unique odors.)

4) Does the child appear clean?
(This observation may give a clue regarding the attitude of the parents or guardians towards the child.)

5) What is the response to various stimuli?
(A sensory perception problem may indicate mineral imbalance. Patterning may be in order.)[11]

6) Is the child manipulating the family? The doctor?
(The problem may be predominantly psycho-emotional.)

Material and Methods

Work began two days per week at the Center for Autism, examining and observing local students. During the first year there were 25 children who could be studied. The group represented 50% of the 51 students enrolled at the school. All students were admittedly not autistic, but all had enough "autistic" traits to be accepted for admission into the program by the school psychologists.

Ultimately it was obvious that the diagnostic label "autism" was often quite inappropriate as each case was more thoroughly investigated. The label bought certain services for the child from the state, but it also predicted that the child was probably

"incurable". It is believed that this label interferes with the elucidation of individual differences which can be used as clues to the establishment of individualized therapeutic programs. These programs may offer each child his or her best hope for a future outside of an institution.

The investigtive team included

1) John E. Upledger, D.O.,-principal investigator
2) Jon D. Vredevoogd, M.A.-architect and specialist in environmental design
3) Ernest W. Retzlaff, Ph.D., M.P.H.-neurophysiologist
4) Eric M. Gordon, Ph.D.-independent consultant in data analysis, research design, and psychometrics.

Every parameter was studied within the budgetary constraints.

Results

Physical examination revealed that twenty-four of the 25 children presented with severe restriction to mobility of the thoracic cage during the breathing process.

Among the causes of reduced respiratory mobility are: severe postural problems, localized somatic dysfunctions of the thoracic cage, poor neurogenic control of the respiratory reflexes, low-grade mercury toxicity (when due to vapor inhalation), and other possibilities yet to be discovered. Deficiencies of calciuim, phosphorus, and magnesium can all increase myoneural junction excitability and therefore interfere with normal relaxation of the intercostal muscles, a state which is necessary for free breathing mobility.

Three of the children had significantly poor posture while 22 had severe thoracic somatic dysfunction. No severe neurogenic problems or "hard signs" were discovered. None had more than minimal mercury content in the hair.

The therapeutic approach was to institute daily (5 days per week) deep breathing exercises, using 10% CO_2 with 90% O_2 for five minutes. The rationale for this approach was based on the concept that the CO_2 would stimulate respiratory centers and perhaps help to develop neuromechanisms which, although potentially present, had fallen into disuse. In addition, applied manipulative therapy was aimed at the somatic dysfunctions of the thoracic cage, lumbar spine, and postural problems. The therapeutic correction of thoracic vertebral and costal somatic dysfunctions allows free mobility of the thoracic cage upon inhalation and exhalation, which results in an increase in vital capacity without increasing patient effort. Lumbar somatic dysfunction results in loss of diaphragmatic mobility; thus their correction was imperative in order to improve breathing and gaseous exchange via the lungs.

The primary postural abnormality which interferes with respiration is thoracic kyphosis and/or scoliosis. Three significant kyphotic problems and no significant scolioses in the sample were observed. The kyphoses were corrected in order to improve thoracic cage mobility.

Seven of the 25 children had displayed a clinically significant and consistent cyanosis of the fingernail beds.

Within four weeks of treatment as outlined, all fingernail bed cyanosis had disappeared; and thoracic cage mobility was perceptibly improved. The children were breathing much more deeply and were thus receiving a better oxygenation of the blood, with more oxygen being supplied to the brain.

It is not known which, if any, of the two treatments applied was the more effective. It was postulated that the combination was responsible for the results, which were significant.

Autonomic nervous system imbalance was suggested as being due to an increased tonus, thoracic myofascial trigger distribution, frequent cardiac rate elevation, and hyperresponsiveness to various types of stimuli in twenty-three of the 25 children examined initially. The phosphorus levels in the hair were high normal or above, while the calcium levels were, with three exceptions, midnormal or subnormal. Melvin Page has stated that in sympathetic dominant persons, the Ca:P ratio will shift toward phosphorus.[14]

Osteopathic manipulative mobilization of the lumbar, thoracic, and cervical spines was carried out in order to reduce sympathetic nervous system tonus.[27]

Craniosacral examination revealed marked restriction of normal mobility of the bones of the skull, pelvis, and transverse diaphragms of the body. No other group of children has presented such marked restrictions. They did not seem osseous in nature but gave the impression that the membrane (dura mater) system was tight and non-compliant.

It is suggested that the more classically autistoid a child seems, the more restriction there is on craniosacral system mobility. This restriction has an elastic quality which suggests membrane abnormality.

Fundoscopic examination of the retinal blood vessels was extremely difficult to carry out. It was attempted in every child and was successful in only seven cases. Of these cases, four presented a discrepancy in retinal blood vessel diameter between the right and left sides; i.e., the vasculature appeared dilated on one side and constricted on the opposite.

The use of an A.G.A. thermoscan machine for two days at the Center for Autism, disclosed that the heat output on the two sides of the forehead was not symmetrical in eighteen of the 25 children scanned. This finding is unusual, particularly in children, where one expects to find vascular symmetry; it suggests that further study might be very productive. It was also observed that the infrared output of a patient's hands reflects the therapeutic progress of craniosacral treatment during the individual session: heating of the hand corresponds to correction of dysfunction, while cooling of the hand occurs during an unsuccessful treatment session.

Blood analysis by electrophoresis was done on two occasions, one year apart. The first time 14 samples were obtained; one year later, 22 samples were examined, twelve of which were repeats.

A) All electrophoretic patterns of immunoprotein migration were abnormal. None of the 36-sample total presented a normal protein migration pattern.

B) In the electrophoretic migration of the lipids, 60% of the patterns were abnormal. Although many different patterns were presented from these data, a higher incidence of lipid metabolism problems than in a general child population would appear to suggest a prediabetic state. This abnormal lipid migration may be related to chromium deficiency, which was present in 70% of the total sample.

C) LDH isozymes = Thirty-four of the 36 samples tested revealed an elevation above normal of the 5th (muscle) fraction of the LDH enzyme. This LDH fraction (V) is liberated from damaged muscle and could be due to continuing injury, to which autistic children fall prey; on the other hand, the LDH fraction could have some other metabolic significance: it suggests a necrotic or tissue-destructive process.

D) Alkaline phosphatase isozyme electrophoretic patterns were all considered normal.

E) CPK isozyme patterns showed a flattening of the brain fraction in thirty of 36 cases studied. No precedent exists for a subnormal value of CPK brain fraction. It is felt that further study in this area is most certainly justified.

From the electrophoretic studies one can see an emerging pattern of abnormality involving the immunoproteins, muscle fraction of LDH, and perhaps the brain fraction of CPK.

The lipid panel abnormalities may suggest a prediabetic state relating to chromium deficiency, which was found in 70% of the hair samples.

Blood Ca:P ratios were computed on 36 cases to determine whether this work would substantiate Page's findings. Page states that the ideal Ca/P ratio is 2.5/1 and that an elevation above 2.5/1 shows sympathetic hypertonus.[14] Of 36 Ca:P ratios computed thirty-five were relatively high in phosphorus, giving a ratio of less than 2.5. According to Page, this finding favors a hypersympathetic autonomic tonus. The only Ca:P ratio in this sample above 2.5 was 2.7; it belonged to the Lesch-Nyhan child. These ratios were computed on the bases of the tests done on blood sera, not on hair mineral content.

Other blood tests carried out included glucose, uric acid, urea nitrogen, creatinine, total serum protein, and albumin. None revealed significant abnormalities.

Hair analysis for mineral content was carried out on a total of 41 children. The first year 18 samples were analyzed; one year later 23 samples were done, with five repeats.

The results of the hair analysis for mineral content are shown in Table I.

Statistically significant patterns failed to emerge; and it was not possible to point to specifically interrelated deficiencies and/or excesses of mineral content which recurred in this sample.

Also, data shows that no single mineral abnormality cuts across the entire sample. Over 50% of the children were found to have deficient levels of sodium, potassium, copper, manganese, chromium, and/or molybdenum. Elevations of aluminum and/or phosphorus occurred in over 50% of this sample. None of the toxic minerals (mercury, cadmium, arsenic, and lead) for which hair analysis was done appeared in high levels in these children. The most significant finding was moderate levels of cadmium in 18% of the children. Moderate levels of lead were present in 9% of the

TABLE I
Results Obtained by Hair Analysis

Essential Trace Minerals

	High	Normal	Low
Calcium	17%	65%	18%
Magnesium	30%	52%	18%
Sodium	22%	21%	57%
Potassium	17%	22%	61%
Iron	9%	47%	44%
Copper	4%	39%	57%
Manganese		26%	74%
Zinc	9%	47%	44%
Chromium		30%	70%
Selenium		70%	30%
Aluminum	70%	30%	
Lithium		100%	
Nickel		92%	8%
Cobalt		100%	
Phosphorus	57%	43%	
Molybdenum	26%	24%	50%

Toxic Minerals

	High	Moderate	Minimal	Undetectable
Mercury			34%	66%
Cadmium		18%	22%	60%
Arsenic		4%	4%	92%
Lead		9%	43%	48%

children, and moderate levels of arsenic were present in 4% of the children. These levels certainly do not suggest toxicity of any of these minerals as an etiologic agent.

However, it is not clear whether the hair necessarily reflects the depositions of the various minerals in different body tissues. If the hair is considered as an excretory organ, then perhaps higher levels of toxic minerals in hair would indicate a higher efficiency of excretion of the toxic substance, which could suggest lower body tissue levels. Conversely, when hair levels of a toxic mineral are low, efficiency of the hair in the excretory process, at least for this toxic substance, may be poor. The results of this situation would be that more of the substance accumulates in the body.

Biological Functions and Signs of Deficiency and Toxicity for the Minerals Assayed by Hair Analysis

This section presents a compilation of all of the accumulated data relating to the various minerals for which the children were tested.

Calcium—Biological Functions:[13]

65% of the samples presented with normal levels of calcium on hair analysis.
17% were above the normal range.
18% were below normal in calcium content

1) Important in muscle contractility. Calcium deficiency increases the excitability of the myoneural junction. It was found that frequently hyperkinetic children present with a markedly increased muscle tonus at the base of the skull posteriorly and in the upper cervical region. Relaxation of these tissues will often result in an immediate and dramatic reduction of hyperkinetic activity. Calcium deficiency may certainly contribute to the hypertonic state of these muscles and thereby contribute to hyperkinetic behavioral problems.
2) Required in the synthesis of acetycholine.
3) Exists as a cofactor in several enzymes.
4) Helps maintain acid-base balance.
5) Increases cell membrane permeability.
6) Activates prothrombium in coagulation cascade.
7) Is a major component of bones and teeth.
8) Aids in body utilization of iron.
9) Lowers histamine levels.
10) Essential for proper utilization of Vitamins A, C, D.

Signs of Calcium Toxicity Include:[28]

1) Renal lithiasis.
2) Cardiac disturbances.
3) Deposition in tissues and joints.

Signs of Calcium Deficiency Include:[15]

1) Nervousness and confusion.
2) Mental depression.
3) Insomnia and fatigue.
4) Irritability.
5) Numbness and paresthesias.
6) Dizziness.
7) Conjunctivitis and photophobia.
8) Neuralgia and neuritis.
9) Muscle cramps and spasms.
10) Increased susceptibility to infections and allergies.
11) Cardiac palpitations.
12) Retarded growth.
13) Increased uptake of toxic minerals, such as lead, mercury and cadmium.
14) Osteomalacia.
15) Osteoporosis.
16) Tooth decay.
17) Rickets.

Calcium deficiency can be caused by increased intake of oxalic acid (chocolate, spinach, beet greens, etc.) and/or phytic acid (outer layers of cereal grains), and by steroid depression of calcium absorption. This may be why chocolate results in hyperkinetic behavior via increased muscle tonus.

Magnesium—Biological Functions:[13], [16]

52% of the samples presented with normal levels of magnesium in hair analysis.
30% were above the normal range.
18% were below the normal range.

1) Essential in muscle contractility and relaxation.
2) Necessary for neurotransmission.
3) A natural tranquilizer.
4) Found in over 300 enzymes in humans.
5) Necessary in protein, fat, and carbohydrate metabolism.
6) Necessary for biosynthesis of thiamine.
7) Helps regulate acid-base balance.
8) Involved in lecithin production.
9) Adds strength and hardness to tooth enamel and bone.

Signs of Magnesium Toxicity Include:[28]

1) Central nervous system depression.
2) Reduction of pain sensitivity due to inhibition of synaptic transmission through the sympathetic ganglia.
3) Reduced conduction at peripheral myoneural junctions.

4) Lethargy, drowsiness.
5) Finally, ataxia, stupor, and coma.

Signs of Magnesium Deficiency Include:[24]

1) Depression and confusion.
2) Hyperactivity and insomnia.
3) Muscle cramps and restlessness.
4) Hypersensitivity to sound.
5) Nervous irritability.
6) Seizures.
7) Loss of thiamine, calcium, and potassium.
8) Eneuresis.
9) Tremors.
10) Cardiac arrythmias and tachycardia.
11) Impaired protein metabolism.
12) Atherosclerosis, hypertension, senility.
13) Renal lithiasis.

Sodium—Biological Functions:[13]

21% of the samples presented with normal levels of sodium on hair analysis.
22% were above the normal range.
57% were below the normal range.

1) Involved in propagation of nerve impulses.
2) Involved in active transport mechanisms.
3) Involved in protein and amino acid metabolism.
4) Essential part of acid-base balance.
5) Major cation of interstitial fluid and contributor to osmolarity.
6) Necessary for HCl production in the stomach.
7) Part of bone matrix.

Signs of Sodium Toxicity Include:[28]

1) Dizziness.
2) Edema.
3) Depression.
4) Irritability.
5) Hypertension.

Signs of Sodium Deficiency Include:

1) Weakness.
2) Muscle cramps.
3) Weariness and lassitude.
4) Respiratory failure.
5) Heat exhaustion.

Potassium—Biological Functions:[13]

22% of the samples presented with normal levels of postassium on hair analysis.
17% were above the normal range.
61% were below the normal range.

1 Essential for propagation of nerve impulses.
2) Functions in glycogenesis, protein, and amino acid metabolism.
3) Predominant intracellular cation.
4) Contributes to osmolarity.
5) Essesntial in acid-base balance.
6) Necessary for myocardial conduction and repolarization.

Signs of Potassium Toxicity Include:[28]

1) Apathy.
2) Muscle fatigue.
3) Loss of appetite.
4) Characteristic ECG changes.

Potassium toxicity is often seen in conjunction with heavy metal toxicity.

Signs of Potassium Deficiency Include:

1) Muscle fatigue, muscle cramps with exercise; later, depression of deep tendon reflexes; finally, a flaccid paralysis.
2) Mental apathy.
3) Hypoglycemia.
4) Constipation.
5) Cardiac arrythmias and depolarization with characteristic ECG changes.
6) Excessive sodium retention with toxic sequellae.

Iron—Biological Functions:[13], [25]

47% of the samples presented with normal levels of iron on hair analysis.
9% were above the normal range.
44% were below the normal range.

1) Esssential part of hemoglobin, myoglobin, and other body proteins.
2) Part of cytochrome system.
3) Cofactor in certain metalloenzymes.

Signs of Iron Toxicity Include:[28]

1) Liver and pancreas damage.
2) Secondary diabetes.
3) Collagenosis.
4) Osteoporosis.
5) Scurvy secondary to inactivation of Vitamin C.

Signs of Iron Deficiency Include:[22]

1) Headaches.
2) "Run-down" feeling and fatigue.
3) Crankiness, poor attention span, poor school performance.
4) Dyspnea on exertion.
5) Paleness of complexion.
6) Lowered resistance to infectious disease.
7) Hypochronic, microcytic anemia.

The most common causes of iron deficiency include malabsorption syndromes, occult bleeding, poor nutrition, and menstrual blood loss.

Copper—Biological Functions:[9, 16]

39% of the samples presented with normal levels of copper on hair analysis.
4% were above the normal range.
57% were below the normal range.

1) Acts as a brain stimulant.
2) Contributes to the myelin sheaths of nerves.
3) Essential to connective tissue integrity.
4) Essential for the production of RNA.
5) Involved in the metabolism of proteins and ascorbic acid.
6) Essential in the formation of hemoglobin.
7) Essential in iron absorption.
8) A component of various enzymes involved in electron transport and energy production mechanisms.
9) Involved in melanin synthesis.

Signs of Copper Toxicity Include:[28]

1) Hyperactivity in children.
2) Postpartum psychosis and/or depression.
3) Mood swings and volatile personality.
4) Schizoid behavior.
5) Speech problems.
6) Wilson's disease.

Zinc deficiency contributes to copper toxicity.

Signs of Copper Deficiency Include:[7, 24]

1) Impaired nerve myelination.
2) Graying and/or loss of hair.
3) Skin lesions.
4) Impaired respiration.
5) Anemia and neutropenia.
6) Blood vessel weakness.

Manganese—Biological Functions:[13], [16]

26% of the samples presented with normal levels of manganese on hair analysis.
0% were above the normal range.
74% were below the normal range.

1) Required for normal neural function.
2) Aids in fat digestion when combined with choline.
3) Component of several enzymes involved in protein, fat, and carbohydrate metabolism.
4) Required for normal bone structure.
5) Required for normal reproduction and mammary gland function.

Signs of Manganese Toxicity Include:[28]

1) Poor appetite
2) Weakness.
3) Depression.
4) Apathy.
5) Impotence.
6) Disturbed sleep patterns.
7) Violence.
8) Temporary insanity.
9) Parkinson's disease.

Signs of Manganese Deficiency Include:[16], [22]

1) Impaired growth and skeletal abnormalities.
2) Impaired reproduction.
3) Glucose intolerance.
4) Reduced growth of hair and nails.
5) Impairment of fatty acid metabolism.
6) Neuropolysaccharide insufficiency.

Zinc—Biological Functions:[8], [13], [15], [23]

47% of the samples presented with normal levels of zinc on hair analysis.
9% were above the normal range.
44% were below the normal range.

1) Used in the storage of neurotransmitters (serotonin).
2) Part of insulin molecule.
3) Essential for growth and development of sex organs and bones.
4) Essential for normal prostate function.
5) Constituent of enzymes concerned with metabolism of nucleic acids, proteins, and carbohydrates.
6) Essential to retinal visual processes.
7) Affects tissue respiration.

8) Aids in the healing of epithelial tissues.
9) Necessary for the proper utilization of Vitamin A.

Signs of Zinc Toxicity Include:[23], [28]

1) Vomiting and diarrhea.
2) Drowsiness and lassitude.
3) Depression of deep tendon reflexes.
4) Tremors.
5) Central nervous system depression.
6) Anemia with copper and iron deficiency.

Signs of Zinc Deficiency Include:[6], [8], [16], [22]

1) Retarded growth.
2) Poor appetite.
3) Loss of senses of taste and smell.
4) White spots on fingernails.
5) Childhood hyperactivity.
6) Seizures.
7) Emotional disturbances.
8) Glucose intolerance.
9) Skin diseases, acne, and pigmentation changes (darkening).
10) Slow healing of epithelial tissue.
11) Lowered resistance to infections.
12) Hypogonadism.
13) Prostate hypertrophy.
14) Sterility.
15) Atherosclerosis.

Schizophrenics and alcoholics lack normal levels of zinc in the hippocampus of the brain.

Chromium—Biological Functions:[10], [13]

30% of the samples presented with normal levels of chromium in hair analysis.
0% were above the normal range.
70% were below the normal range.

1) Involved in glucose tolerance and insulin.
2) Necessary for cholesterol metabolism.
3) Involved in the synthesis of cardiac protein.
4) A component of many enzymes and hormones.

Signs of Chromium Toxicity Include:[28]

1) Cr6+ causes renal lesions and anuria.
2) Contact dermatitis.
3) Cr6+ inhalation produces lesions of the mucous membranes of the respiratory tissues; ultimately, it may result in lung cancer.

Signs of Chromium Deficiency Include:[23]

1) Impaired glucose tolerance.
2) Growth retardation.
3) Impaired ability to cope with psychological stress.
4) Hypercholesterolemia and atherosclerosis.

Selenium—Biological Functions:[28]

70% of the samples presented with normal levels of selenium on hair analysis.
0% were above the normal range.
30% were below the normal range.

1) Essential component of glutathione peroxidase.
2) Antioxidant and, as such, has a "sparing" effect on Vitamin E.
3) Inhibits formation of free radicals.
4) Assists in liver regeneration.
5) Offers some protection against mercury poisoning.

Signs of Selenium Toxicity Include:[28]

1) Somnolence.
2) Depression and lassitude.
3) Dermatitis.
4) Loss of hair, nails, and teeth.
5) Retarded growth and reproduction.
6) Garlic odor on breath.
7) Carcinogenesis.
8) Paralysis and death.

Signs of Selenium Deficiency Include:[25]

1) Muscle degeneration.
2) Premature aging.
3) Liver damage.
4) Glutathione peroxidase insufficiency.
5) High incidence of cancer.
6) Increased toxicity from cadmium, arsenic, mercury, lead, and cobalt.

Aluminum—Biological Functions:[13], [25]

30% of the samples presented with normal levels of aluminum in hair analysis.
70% were above the normal range.
0% were below the normal range.

No biological function for aluminum is indicated within the human body.

Signs of Aluminum Toxicity Include:[3], [18]

1) Memory loss.

2) Brain dysfunction.
3) Premature senility.

Aluminum accumulates in the human hair.

Lithium—Biological Functions:[7, 13]

100% of the samples presented with normal levels of lithium on hair analysis.

1) Associated with autonomic nervous system function.
2) Involved in sodium transport and metabolism.

Signs of Lithium Toxicity Include:[3, 28]

1) Drowsiness.
2) Muscle weakness.
3) Staggering gait.
4) Tremor.
5) Vomiting and diarrhea.
6) Central nervous system toxicity.
7) Sedation.

Lithium interferes with carbohydrate metabolism by substituting for the potassium ion. It speeds presynaptic destruction of epinephrine and norespinephrine. It inhibits the neuronal release of serotonin and norepinephrine. It decreases cerebral glutamate content.

Signs of Lithium Deficiency Include:[23, 28]

Mental and nervous disorders such as: manic-depression, psychosis, and paranoid schizophrenia.

Nickel—Biological Functions:[13]

92% of the samples presented normal levels of nickel on hair analysis.
0% were above the normal range.
8% were below the normal range.

1) Involved in several enzyme systems.
2) Involved in several hormone structures.
3) Offers structural stability to many biological macromolecules.

Signs of Nickel Toxicity Include:[28]

Brain degeneration

Signs of Nickel Deficiency Include:[13]

1) Relates to multiple enzyme and hormone deficiencies.
2) Reduction of structural stability of biological macromolecules.

Cobalt—Biological Function:[13], [25]

100% of the sample presented with normal levels of cobalt on hair analysis.

1) Aids in hemoglobin formation.
2) Component of Vitamin B-12.

Signs of Cobalt Toxicity Include:[28]

1) Polycythemia.
2) Pericardial effusion.
3) Hemorrhages in several organs, including the liver, adrenals, and kidneys.

Signs of Cobalt Deficiency Include:[7], [15]

1) Pernicious anemia.
2) Methylmalonic acid uria.

Phosphorus—Biological Functions:[13]

43% of the samples presented with normal levels of phosphorus on hair analysis.
57% were above the normal range.
0% were below the normal range.

1) Necessary for healthy and efficient function of the nervous system.
2) Part of high energy compounds ATP, etc.
3) Part of phospholipids, nucleoproteins, vitamins, and many other compounds.
4) Necessary for fat assimilation.
5) Necessary for digestion of niacin and riboflavin.
6) Contributes to acid-base balance.
7) Essential part of bones and teeth.

Plutic acid (bran) can interfere with phosphorus absorption. Phenobarbital can contribute to phosphorus deficiency.

Signs of Phosphorus Toxicity Include:[28]

1) Hypertonus of sympathetic nervous system.
2) Calcium deficiency.

Signs of Phosphorus Deficiency Include:[10], [14], [24]

1) Deficient nerve and brain function.
2) General weakness.
3) Retarded growth.
4) Reduced sexual power.
5) Poor mineralization of bone and rickets.

Molybdenum—Biological Functions:[13]

24% of the samples presented with normal levels of molybdenum on hair analysis.

26% were above normal range.
50% were below normal range.

1) Involved in carbohydrate metabolism as part of oxidation enzymes.
2) Protects tooth enamel.
3) Antagonizes copper.

Signs of Molybdenum Toxicity Include:

1) Inability to handle stress.[28]

Signs of Molybdenum Deficiency Include:

1) Dental caries.[28]

Signs of Mercury Toxicity Include:[13], [28]

1) Insidious onset of central nervous system toxicity, which is typified by anxiety, emotional lability and exaggerated responses, insomnia, dysphagia, dyscoordination, sensory losses, ataxia, memory loss, hallucinations, peripheral neuropathy, and photophobia.
2) Gingivitis.
3) Urticaria.
4) Excess salivation.
5) Diarrhea.
6) Anemia + leukopemia.
7) Liver and renal damage.
8) Muscle pain.
9) Blue line on gums; loosening of teeth.
10) Brain retains inhaled mercury vapor.

Signs of Cadmium Toxicity Include:[13], [28]

1) Central nervous system toxicity.
2) Hyperactivity.
3) Anosmia.
4) Excessive salivation.
5) Dry, scaly skin.
6) Appetite loss.
7) Carcinogenesis.
8) Renal damage.

Signs of Arsenic Toxicity Include:[13], [28]

1) Central nervous system toxicity.
2) Hyperactivity.
3) Hyperreflexia.
4) Hallucinations.
5) Abdominal pain.

Signs of Lead Toxicity Include:[5, 13, 28]

1) Central nervous system toxicity includes loss of recently acquired skills, lethargy, motor dysfuntion, behavioral disorders and retardation, convulsions, ataxia, and stupor.
2) Anemia.
3) Anorexia.
4) Vomiting.
5) Apathy.
6) Pica.

In an additional group of twelve learning disabled children no significant heavy metal toxicity was found and no patterns of abnormalities that crossed the sample except multiple deficiencies, with the exclusion of zinc and potassium.

Physical Environment

Additionally, a great deal of data was collected regarding the effect of the physical environment through the monitoring of autistic children's classroom behavior by using time lapse photographs; also concurrently recorded were measurements of the internal environment of the "autistic" classrooms. This included temperature, humidity, barometric pressure, sound and light intensity levels, and magnetic field strength fluctuations. All monitoring of instruments was done at one frame/second. Simultaneously, the same conditions outside the building were monitored.

Conclusions regarding the effects of the physical environment upon the behavior patterns of the children enrolled at the Center for Autism include the following:

1) Weather conditions in Michigan are constantly changing: 24-hour cycles are superimposed on 60-hour and longer cycles.

2) All of these cycles are modified during the full moon. Sea level pressure drops, and circadian rhythm fluctuation amplitudes are suppressed in the out-of-doors. Conditions inside the building were constantly suppressed: inside the building the children were under the influence of physical conditions which simulated a constant full moon.

3) In the classroom a relatively high constant temperature of 76-80°F was maintained with humidity above 50%; such conditions produce a (+) ionic charge. Were the humidity reduced to less than 50%, a negative ionic charge would be produced. The natural and preferable environment is one of negative ionic charge. Positive ionic charge slows wound healing,, causes headaches, depression, and irritability. When either the room temperature or humidity was reduced, behavior improved as ionic charge changed from (+) to (—).

4) When children are moved from outside to indoors, they must adapt to suppressed circadian rhythm, artificial, limited-spectrum light, and positive ionic charge: behavior is better out-of-doors.

5) Barometric change, whether rising or falling, increases hyperactivity and destructive behavior.

Discussion and Conclusions

The research described was not experimentally designed. Its purposes were threefold: to observe and examine children; to collect and search the data for significant recurring coincidences; and then to formulate relevant and probing questions. It is felt, however, that tightly controlled experimental designs involving human subjects are often difficult, particularly in studies with children. It was noticed that they totally seduce the investigative team, as they would be unable to withhold any form of potentially beneficial treatment from the children in the interest of science.

Among the recurring behaviors observed which present a clinical significance are "head-banging", "thumbsucking", "toe-walking", "self-mutilation", and "self-stimulation". Most of these behaviors are considered inappropriate. Often a great effort is made by teachers and trainer to condition the children out of these behaviors. Observation of their behaviors, when integrated with the physical findings and test results, indicates that many of these "inappropriate" behaviors are explained as follows:

1) Head-banging: Observation and examination revealed that the head-banging children were usually banging in one or two rather specific areas of their heads. Craniosacral system evaluation revealed that the areas where the children focused the banging were usually areas which were most restricted to normal craniosacral system motion. The head banging might therefore represent the child's attempt at self-correction of craniosacral system dysfunction. When craniosacral system mobility was restored by manipulative treatment, head-banging diminished.

2) Thumbsucking: Close observation of the "thumbsucking" child usually revealed that the child was not "sucking"; rather he was pressing on the roof of his mouth. This pressure cause a force to travel through the hard palate cephalad through the vomer bone and then to the body of the spehnoid bone. In craniosacral system mechanics the spehnoid is the "keystone" which drives the motion of the rest of the system.

Frequently pressure is used here therapeutically to mobilize a cranial base which is jammed into restriction of motion. The "thumbsucking" children all had very restricted cranial bases. When craniosacral base mobility was established, "thumbsucking" activity decreased.

3) Toe-walking: This is a very common activity for autistic children. Examinations demonstrated that by restoration of normal physiological function to the pelvis the toe-walking could temporarily be alleviated. The difficult part was the discovery of the underlying cause for the pelvic dysfunction. However, it was suggested that before one forcibly interupts the toe-walking activity, reasons for the activity should be thoroughly understood. A 9-year old girl was an incessant toe-walker. On two occasions, the toe-walking was interrupted with normal walking for approximately one hour each time. The interruptions were achieved by the use of functional manipulative treatment aimed at the pelvis. Over the team's strong objections orthopedic surgery was performed to lengthen her Achilles tendons. She would not eat after surgery; she would not ambulate. She never walked again. She sat

in a wheelchair for six months after surgery and then died. The cause of death was vague, at best. She had wasted away, finally succumbing to an acute infectious disease process which involved her lungs.

Perhaps she had needed to toe-walk in order to provide some sort of stimulus input which she instinctively understood as necessary for her body to function. Unfortunately, no one fully appreciated her needs.

4) Self-mutilation: Such activities either stop or dramatically decrease when various sources of pain were removed, an observation which leads one to believe that self-mutilation is indeed an instinctively purposeful activity. It may substitute a pain which is under the control of the child for a pain which is not; the former situation may be preferable. Self-mutilation may stimulate endogenous endorphin production and thereby actually offer relief for both pains as well as inducing a euphoric state.

5) Self-stimulation: Included here are smelling, tasting, touching, being touched, looking into lights, listening, spinning, intricate repetitive motions, etc. If one accepts the concept that brain develops both structurally and functionally in response to stimulus input, it begins to make sense that self-stimulation may be the instinctive attempt at enhancing the development of underdeveloped brain regions. Before interrupting these activities one needs to understand their purposes and develop aceptable and more effective substitute activities.

Physical examinations revealed the aforementioned reduction of thoracic cage motion with respiratory activity, a condition which seemed to correct very well with 10% CO_2 — 90% O_2 breathing activity combined with manipulative treatment aimed at thoracic cage mobilization. The improved respiratory activity continued after the treatment ended, which would indicate that the causes for poor respiratory excursion were not ongoing.

The most outstanding physical finding by far was the very marked elastic (membranous) restriction to craniosacral system mobility. Correction of this situation often coincided with an end to head-banging, self-mutilation, and withdrawal. The children became emotionally expressive and affectionate as the cranial treatments progressed week-by-week. Researchers do not know whether the weekly attention with the treatment group was the cause of the change in emotional activity and sociability, whether it was the actual structural corrections which were made within the craniosacral system, or whether it was a combination of all.

The results of blood electrophoresis are inconclusive but do indeed suggest a pattern of abnormal tracings. The suggestion of a pathological immune process contributed by the serum protein electrophoresis needs further study. The elevation of LDH-5 and the flattening of the CPK-brain fractions also need further study under more controlled conditions.

The results of the hair analyses for mineral content have been given in detail. One cannot draw any firm conclusions from this data except that numerous potential culprits which could cause or contribute to brain dysfunction were observed. None of the sample was totally normal. Each child had at least one problem with mineral toxicity, which is known to have the potential for causing brain function problems.

The establishment of cause and effect relationships in this area is most difficult. The research team tends to think that the mineral disorders which were found were contributory towards the continuation of the problems with behavior but were not necessarily primary causes.

In conjunction with the other therapies mentioned above, individual nutritional programs were formulated for each child and evaluated. Research team members met with parents and reviewed the nutritional programs, and made individual suggestions, etc.

Measurements of physical environment would suggest that much work must be done in this area before any real conclusions can be drawn. It was felt that symptomatic behavioral improvement could be achieved by positive management of the physical environment; although, from these observations of autistic behavior, it is felt that physical environment has played a primary etiologic role.

The feeling at this point regarding etiologic factors in autistic behavior is that the behavior is the result of brain dysfunction. The cause of the brain dysfunction may be multiple, but high on the etiologic scale is a disease process or biochemical abnormality which has resulted in a change in the physical character of the dura mater. This change has caused the dura mater to be less compliant and therefore to restrict the normal physiological mobility of the craniosacral system.

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