Hair Mineral Content as a Predictor of Mental Retardation

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Abstract

Recent research has discovered childhood mental retardation is related to the presence in the body of above-normal levels of certain mineral elements, especially lead and cadmium. This study investigated the relationships between mineral elements and mild and borderline mental retardation and determined which minerals, if any, separated a group of mentally retarded children from a nonretarded control group. The retarded group had significantly raised hair-lead and hair-cadmium concentrations. There were also differences in the mean levels of seven other minerals. Discriminant function analysis revealed that by using lead, magnesium, cadmium, selenium, cobalt, molybdenum, sodium, and zinc, subjects could be correctly classified as nonretarded or retarded with 83.1 percent and 75.0 percent accuracy respectively. It is concluded that continuing research is needed to study the relationship between mineral element patterns and childhood mental retardation.

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Certain mineral elements, particularly lead, have been demonstrated to be tetragenic and are currently under suspicion as an etiologic agent in learning and behavioral problems. Minerals comprise five percent of the molecular composition of our bodies and serve a wide range of functions. They may be crucial for the functioning of the central nervous system or unwanted and toxic. Additionally, there are many minerals of hypothesized yet undemonstrated value or detriment. In spite of the significance of mineral elements to neurobehavioral development, with the possible exception of lead, the relative paucity of research dealing with the effects of element levels on cognitive functions is noteworthy.

Certain recent studies suggest a significant role for the minerals lead and cadmium in mental retardation (Needleman, Gunnoe, Leviton, Reed, Peresie, Maher and Barrett, 1979; Perino and Ernhart, 1974; Wunderlich, Cameron and Loop, 1980). While the neurological consequences of high dosages of lead and cadmium are well known, the studies

cited above suggest lead and cadmium levels far below those associated with overt lead or cadmium poisoning may also have a tetragenic effect on the neurological system.

This study had two major purposes. The first purpose was to investigate the relationship between mineral elements and mild and borderline mental retardation in children without demonstrable cause for their mental deficit. The second purpose was to determine which minerals, if any, separated the mentally retarded children and a nonretarded control group. In addition, from the subset of minerals that significantly discriminated between the two groups, a determination of the relative importance of each mineral to the discrimination between the two groups was to be made.

METHODS

Subjects

The 135 subjects in this study were drawn from schools in the Tennessee counties of Jackson, Overton, Putnam, Scott, and Smith. These counties are situated in the Upper Cumberland Region o f Tennessee, an economically depressed mountainous region geographically removed from any urban area. The school included a preschool developmental center, seven elementary schools, and two high schools (grades 7 to 12).

All of the mentally retarded subjects were receiving special educational services. Their diagnosis of retardation was based on an overall evaluation from a series of consultations by school psychologists, classroom teachers, and appropriate other specialists where indicated. The diagnostic evaluation included the administration of a standardized intelligence test. All of the retarded children in the sample had an IQ of 55 to 84 inclusive (The American Association of Mental Deficiency classifies an IQ of 55 to 69 as "mild mental retardation" and 70 to 84 as the "borderline range"). In addition, all of the retarded children's evaluations included systematic documented observations by appropriate specialists of impaired adaptive behavior in the home, community, and school.

Presence or Absence of Probable Cause

All of the children's school records which met the IQ criteria were reviewed to determine whether there was a known or highly probable medical reason for their retardation. On the basis of this review, children with "probable cause," e.g., hydrocephaly, brain injury, were removed from the study. In addition, any child with a history of diagnosed metal poisoning was excluded from the sample study. Only children with unremarkable medical histories for mental retardation were assigned to the "etiology unknown" group (N=64).

The control subjects (N=71) were randomly drawn from the general school population at the ten schools. No IQ determinations were available for the normal comparison group, but it appears safe to assume a relative absence of mental retardation in a randomly drawn general school population. Furthermore, a survey of the teachers' reports obtained for each child indicated average or above average academic achievement and learning ability.

Table 1 shows the relevant demographic data for the two resulting groups of subjects. There were no significant differences between the groups in socio-economic status or in the sex and ethnic group distributions. The groups did differ significantly in age with mean age in the retarded group 11.62 and

Table 1 — Demographic Characteristics of 2 groups of Children

	N	Sex	Age (yr.)		Ethnic Group		
		M/F	Mean ± S.D.		Range	Caucasian	Other
Mentally retarded group	64	44/20	11.62	3.06	4-16	64	0
Control group	71	45/26	9.43	2.81	4-15	71	0

Children in each group came from social classes 3,4 and 5 as defined by Hollingshed and Redlich (1958). There was no significant difference in the groups' social class membership.

the control group 9.43 ($p < .001$). None of the control children and two of the retarded children had histories of pica, the behavioral habit of ingesting inedible materials, such as clay, paper, plaster, and paint. Pica has been shown to substantially contribute to increased metal burdens.

Classification of Mineral Elements

After obtaining parental permission, children were asked to submit a small sample of hair (about 400 mg) for trace mineral analysis. Hair samples were collected from the nape of the child's neck, as close to the scalp as possible, by the researchers using stainless steel scissors. The hair samples were then submitted to Doctor's Data Laboratories, Inc., a clinically licensed laboratory in West Chicago, where they were analyzed with three instruments — the atomic absorption spectroproto-meter, the graphite furnace, and the induction coupled plasma torch — to determine five toxic metal levels and 16 nutrient mineral levels. The five toxic metal levels tested for were lead, nickel, arsenic, mercury, and cadmium. The 16 nutrient mineral levels tested for were calcium, magnesium, sodium, potassium, copper, zinc, iron, manganese, chromium, phosphorus, selenium, molybdenum, aluminum, silicon, lithium, and cobalt.

Precise laboratory techniques are used by Doctor's Data Laboratories, Inc., to assure reliability of results and to meet reproducibility requirements. These include:

1. A blind sample is run from the initial steps through the entire procedure to assure reproducibility of methods.
2. At least one of every 10 tests is a standard. Working standards are made to assure proper values.
3. The in-house pool is completely remade and analyzed monthly to eliminate the possibility of precipitating elements and to assure reproducibility.
4. Temperature and humidity are controlled to assure reliability and consistency of the testing instruments.
5. The hair samples are weighed to the thousandth of a gram (.001 g is equal to approximately four hairs, 1 inch (.0254 m long); and only Volumetric Flasks, the most accurate available, are used for diluting the ashed sample.
6. Lot-number control sheets for all reagents are used to assure uniformity. Records are kept and available for inspection.
7. All glassware is acid washed in-house before use and between each use, including acid prewashed disposable test tubes.
8. The water used at Doctor's Data Laboratories, Inc., is virtually mineral free, rated at 18+ MEG.

Reports summarizing the significant findings of the hair analysis for each subject were received from Doctor's Data Laboratories, Inc., subsequent to analysis. A report summarizing the laboratory findings of Doctor's Data Laboratories, Inc., consisted of two main sections. The first section summarized the significant findings related to the 16 nutrient-mineral levels. These findings were based on a statistical comparison of the levels determined in the present analysis with those observed in a normal population. The second section dealt with the five toxic metals. If the mineral analysis indicated any of these elements to be above generally accepted upper limits, the name of this element was printed on the report and supplemental information was enclosed with the report. In addition, this section of the report listed both the observed hair level and the suggested upper limit for each metal and plotted each level in relation to the upper limit.

Hair: A Useful Diagnostic Tool

Every part of the human body contains at least a few atoms of every stable element in the periodic table. Although a large number of these elements are found in detectable amounts in human tissue, blood, and urine, hair, in particular, contains a higher concentration of many of these elements. Trace elements are accumulated in hair at concentrations that are generally higher than those present in blood serum, provide a continuous record of nutrient-mineral status and exposure to heavy metal pollutants, and may serve as a probe of physiologic functions (Gordus, 1973; Maugh, 1978). Scalp hair has several characteristics of an ideal tissue for epidemiologic study in that it is painlessly removed, normally discarded,

easily collected, and its contents can be analyzed relatively easily (Hammer, Finklea, Hendricks, Shy and Horton, 1971).

The best results have been obtained with heavy metal pollutants such as lead. Numerous investigations worldwide have shown that concentrations of lead and other heavy metals in the hair provide an accurate and relatively permanent record of exposure, and that there is a strong correlation between concentrations in hair and concentrations in internal organs (Kyle and Pease, 1966; Schroeder and Nason, 1969).

RESULTS

The two groups of children were compared for hair element concentrations. As shown in Table 2 the mean hair concentration of lead in the retarded children with unknown etiology was considerably above that of the control children. The retarded group had a mean hair-lead of 14.10 while the control group had a mean hair-lead of 7.09. The data were analyzed with the t-test for two independent samples design of SPSS (Nie, Hull, Jenkins, Steinbrenner and Bent,

Table 2 — Results of Trace Mineral Analysis Mean ± S.D.

Trace Mineral	Mentally Retarded Group (ppm)		Control Group (ppm)		Normal Range a (ppm)	
Lead	14.10 ±	7.60	7.09 ±	5.22		15.00[b]
Nickel	0.60 ±	1.05	0.75 ±	0.98		1.80[b]
Arsenic	1.85 ±	3.08	1.77 ±	2.18		0.40[b]
Mercury	0.56 ±	0.62	0.45 ±	0.45		3.00[b]
Cadmium	0.62 ±	0.58**	0.37 ±	0.42		1.60[b]
Calcium	318.12 ±	443.44	221.27 ±	173.95	204.00 -	712.00
Magnesium	55.83 ±	52.39*	23.95 ±	24.14	29.00 -	137.00
Sodium	1644.71 ± 1814.93**		744.43 ±1087.11		346.00 -	1080.00
Potassium	870.15 ±1009.19**		408.35 ±	689.99	42.00 -	431.00
Copper	13.16 ±	8.11	12.52 ±	9.40	17.00 -	67.00
Zinc	157.35 ±	47.97	139.72 ±	91.90	104.00 -	288.00
Iron	66.75 ±	47.00***	43.57 ±	59.79	21.00 -	50.00
Manganese	2.99 ±	3.26***	1.47 ±	4.40	0.62-	1.97
Chromium	1.06 ±	1.26	0.98 ±	1.22	1.03-	3.23
Phosphorus	117.93 ±	34.34***	153.78 ±	110.17	108.00 -	203.00
Selenium	0.46 ±	0.59***	2.61 ±	8.21	0.08-	0.64
Molybdenum	1.04 ±	0.90	1.25 ±	1.44	0.59-	2.55
Aluminum	9.97 ±	10.49	9.83 ±	7.38	2.89-	82.51
Lithium	0.26 ±	0.58	0.23 ±	0.35	Not established	
Silicon	46.18 ±	70.28	23.81 ±	30.16	Not established	
Cobalt	0.23 ±	0.20	0.17 ±	0.17	Not established	

a Theoretical Normal Range established by Doctor's Data, Inc. (1977) b Normally tolerated limit established by Doctor's Data, Inc. (1977) *p < .001 by two tailed t test **p < .01 by two tailed t test ***p < .05 by two tailed t test

1975) yielding a significant t value for lead (t = 6.30, 133, p < .001) indicating that the variation between the two means was unlikely to have occurred by chance.

Fifteen ppm is considered to be the normally tolerated limit of hair lead (Doctor's Data, 1977). Twenty eight of the 64 retarded children had elevated hair-lead concentrations (range = 2.0 - 36.0 ppm), while only six of the 71 control children had hair-lead concentrations above the normally tolerated limit (range 0.5 - 29 ppm). Thus, approximately 44 percent of the retarded children were elevated in lead compared to approximately eight percent of the nonretarded children. No children in this study showed extreme concentrations associated with lead poisoning (>100 ppm).

The results of the t-tests on the other elements showed differences between the groups in the mean levels of cadmium, magnesium, sodium, potassium, iron, manganese, phosphorus, selenium, and silicon.
A discriminant analysis was then performed using a program from the **Statistical Package for the Social Sciences, Release 8** and **SPSS Update** (Hull and Nie, 1979). The stepwise method using Wilks lambda was employed to ascertain the relative contributions of the minerals to the separation of groups.

Table 3 shows the results of the analysis. The combination of lead, magnesium, nickel, cadmium, selenium, cobalt, molybdenum, sodium, and zinc in order of entry into the discriminant function significantly separated the normal and handicapped children (F 9, 125 = 8.62, p < .05). Of those minerals lead, magnesium, nickel, and cadmium contributed uniquely over and above the previously entered minerals to the discrimination between groups (F=39.71,8.81,3.77, and 7.00, respectively). Finally, the standardized canonical discriminant function coefficients revealed that lead is the most important (.57) followed by nickel (-.39) cadmium (.39) and magnesium (.38).

On the basis of the discriminant function 83.1 percent of the nonretarded control

Table 3 — Summary of the Stepwise Discriminant Analysis

Step	Mineral	A[a]	R2b	^R^{2c}	rd	Fe	df
1	lead	.77	.23	.23	.48	39.71***	1,133
2	magnesium	.72	.28	.05	.37	8.81**	1,132
3	nickel	.70	.30	.02	-.07	3.77*	1,131
4	cadmium	.67	.33	.03	.23	7.00**	1,130
5	selenium	.65	.35	.02	-.18	3.26	1,129
6	cobalt	.64	.36	.01	.16	1.19	1,128
7	molybdenum	.64	.36	.00	-.09	1.56	1,127
8	sodium	.62	.38	.02	.29	2.58	1,126
9	zinc	.62	.38	.00	.12	1.18	1,125

Note: -N = 135.
a Wilks lambda (^ = 1-R^2) b Squared multiple correlation
c Incremental increase in R^2 contributed by the variable entered at that step d Simple (zero-order) correlation
e Test of the significance of the variable added at that step *F < .05
**F < .01 ***F < .001

children and 75.0 percent of the retarded children were correctly classified. These percentages are optimistic however, since the function was applied to the data that produced it. A cross validation of the discriminant function is expected to result in somewhat smaller percentages.

A test of the homogeneity of within-groups covariance matrices revealed a violation of the assumption (Box's M = 462.06, approx. F 45,56825.2 = 9.53, $p < .0001$). The consequences of such a violation on the validity of the statistical tests have not been thoroughly explored. Therefore, a replication of this study on a fresh sample is warranted to appraise the stability of the standardized discriminant coefficients as well as attempt to clarify the validity of the F tests.

DISCUSSION

A discriminant function analysis revealed that by using lead, magnesium, nickel, cadmium, selenium, cobalt, molybdenum, sodium, and zinc, subjects could be correctly classified as nonretarded or retarded with 83.1 percent and 75.0 percent accuracy respectively. Stepwise discriminant analysis revealed that lead accounted for 23 percent of the variance of the two groups, magnesium accounted for an additional five percent of the variance, nickel another two percent, and cadmium three percent. Each mineral contributed significantly, over and above previously entered minerals to the separation of the groups with lead being the most important. Overall, the nine minerals that were entered into the discriminant function accounted for about 38 percent of the variance in the two groups.

Although some of the predictive factors may represent nutritional peculiarities, numerous inexplicable differences remain. It is important, however, that the significantly higher lead and cadmium content in the retarded children relates to a specific literature.

The role of lead toxicity on intellectual development is well documented. Although the retarded children showed considerably lower amounts of lead than those regarded as toxic, increasing evidence suggests that exposure to low concentrations of lead also has deleterious effects on intelligence. Needleman and others (1979) compared children with high and low dentine lead levels on an intelligence test. The children studied came essentially from the same background and were selected from all the children in the first and second grade in two suburban school systems, and thus the impetus of the study was to discern the low effects of lead. The results showed the relatively high lead group did significantly more poorly on the IQ test and all subtests of the Weschler Intelligence Scale for Children. Perino and Ernhart (1974) found blood lead levels of three and six year old children, who showed no signs of acute lead intoxication, correlated negatively with measures of cognitive abilities. Other studies have demonstrated higher lead levels in mentally retarded children "etiology unknown" than in controls (David, McGann, Hoffman and Sverd, 1976; Routh, Mushak and Boone, 1979).

Low level cadmium toxicity is also receiving increasing attention, although studies of its effects on neurobehavioral dysfunctions are lacking. Wunderlich and others (1980) linked mental retardation to increases in cadmium while Phil and Parkes (1977) reported increased cadmium and lead levels in learning disabled children. In this study the retarded children had significantly higher cadmium levels ($p < .01$).

The finding of both increased lead and cadmium levels in the retarded groups is especially disturbing since these potentially lethal minerals may have a negative combining effect which increases the total toxicity of the child's system. Importantly, recent findings (Marlowe, Errera and Ballowe, 1981) indicate lead-cadmium combinations have a significantly more negative relationship to neurobehavioral performance than do individual lead or cadmium levels.

Other than lead and cadmium, magnesium and nickel were the only minerals to contribute significantly over and above previously entered minerals to the separation of the groups. Recent animal research has revealed that dietary supplementation with magnesium enhances the mobilization of lead from bone, thereby leading to increased blood and urinary lead levels (Singh, Thind, Vitale and Pawlow, 1979). Magnesium supplementation permits seques-

tered lead to move from the bone tissue where the lead was presumably innocuous to generally higher overall levels in the soft tissues including the brain. In this study the retarded children had significantly higher magnesium levels ($p < .001$).

Nickel's contribution to the separation of the two groups is inexplicable since nickel's role in cognitive functioning is unexplored. Some authorities view nickel as an essential nutrient mineral, while others view it as toxic and detrimental to health. This study's data suggest that nickel may play an essential role since its canonical discriminant function coefficient was negatively related to the separation of the two groups.

A number of limitations of the study must be considered. First, the determination of probable cause for retardation from reviewing school records is subject to errors common to retrospective studies in general. However, the most common errors in these studies are those of omission rather than commission. It is unlikely that a school record noting brain injury or rubella is inaccurate; rather the error would occur because of absent data on medically significant factors, e.g., prenatal and perinatal factors. The relative inaccuracy implicit in the identification of the etiology unknown group, however, probably leads to a lower mean metal concentration in this group, since the unidentified probable causes which might be erroneously included would be predicted to show metal concentrations comparable to a normal population. Such a prediction is supported by an earlier study in which a mentally retarded sample with "probable etiology" showed no significant difference in lead concentrations from those of a normal control sample, while a group of mentally retarded children "etiology unknown" had statistically raised lead concentrations (David et al., 1976).

Second, results of the comparisons between the two groups need careful interpretation since observed differences in lead and cadmium levels could have derived from variation between the groups in age (controls were approximately 2.2 years younger). In defense of the comparative data, it should, however, be noted that correlational data showed a negative relationship between cadmium levels and age in both groups and a negative relationship between lead levels and age in the retarded group. Moreover, it is medical consensus that the younger the child the greater the risk for lead absorption (Center for Disease Control, 1978). The vast majority of children identified as lead poisoned have been under six years of age and elevated lead burdens occur more frequently in this age group. Factors making younger children more vulnerable to lead exposure include their relatively inefficient metabolism, excretory pathways, and immunological system, and a smaller skeletal structure to store lead (King, 1971).

The findings of this study support the growing body of studies which have associated low or moderate level lead and cadmium effects with neurobehavioral dysfunctions. These studies have linked low or moderate levels of these metals to mental retardation, impaired IQ, deficits in visual, fine, and gross motor coordination, behavioral disorders, and hyperactivity. The data of these studies indicate the continuing need to reexamine metal poisoning concentrations because concentrations previously thought harmless may now have to be considered as an etiological factor in neurobehavioral dysfunctions. Official recognition of this need is reflected in the Center for Disease Control's revised 1975 statement that "30 micrograms per 100 cc of blood" be considered the level at which the child is in potential danger of developing lead poisoning (a revision of the U.S. Surgeon General's 1970 recommendation that 40ug/100 cc of blood be the cut-off point).

Also warranting further examination is subsequent neurobehavioral development of metal burdened children who receive intervention. David and others (1976) reported behavioral gains in hyperactive children treated with lead chelating agents, and Phil, Parkes, and Stevens (1979) reported improvements in the behavior of learning disabled children who received medical and nutritional counseling to reduce lead and cadmium levels.

Finally, knowledge regarding mineral elements and their effect on neurobehavioral functions has rarely been considered in the diagnosis and treatment of mental

retardation. Any major change in this direction should be predicted on a much broader research base than presently exists. It remains true, however, the limited knowledge available regarding the etiological role of mineral element patterns is most often not utilized. The high levels of significance reported here, the presence of geographical and socioeconomic controls, the consistency with a growing literature on the subject, and the failure of educative techniques with many mentally retarded children suggests that mineral element patterns may prove not only a fruitful diagnostic procedure but may also provide answers pertaining to etiology and treatment.

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Letters to the Editor

To the Editor,

I'm writing to respond to your invitation which appeared in the Fourth Quarter 1981 edition of the **Journal of Orthomolecular Psychiatry** in regard to the use of the anti-yeast program developed by Dr. Truss.

I first became aware of Dr. Truss' work in the fall of 1979. Soon thereafter, I prescribed a mold-free, low-carbohydrate diet and nystatin for one of my adult patients with chronic urticaria. This patient was absolutely "desperate."

She had been seen by many, many physicians, including consulting allergists in two university medical centers. Moreover, I had struggled to help her using various means at my disposal for over a year. Nothing worked. And she required two injections of Sus-phrine® each day to control her hives, along with other medications by mouth, including Atarax®.

In addition to her chronic hives, she suffered from a number of mental and nervous system symptoms, including depressions, fatigue and irrational behavior.

At one visit, her husband took me aside and said, in effect, "Doctor, I'm afraid my wife is losing her mind and I feel we should consider sending her to Western State (a regional mental hospital for the State of Tennessee)."

Six days after being put on the Truss program, the hives began to improve. Improvement in the hives and her symptoms, including her mental and nervous system symptoms, rhinitis and headache, continued over the succeeding months. In a year she was "well." No hives, no significant mental symptoms. Now she's working full time in a department store.

Concurrent with the management of this first case, I began to look for other patients, especially adults, who gave a history of:

1. Multiple antibiotic drugs ... especially tetracycline, Amoxicillin®, Ceclor®, Keflex® and Septra®.

2. History of using birth control pills ... especially for prolonged periods of time ... and history of symptoms involving the reproductive organs, especially persistent or recurrent vaginitis.

3. Digestive symptoms, especially severe constipation, alternating at times with diarrhea.

4. Peculiar mental and nervous system symptoms, including not only depressions, but incoordination and feelings of unreality.

Within a few months, I had treated and helped some 20 patients with the "candida problem." I presented my findings to my peers at Medical Staff Rounds at the Jackson-Madison County General Hospital in May, 1980[1].

During the past two years, my interest in the role of Candida and human illness has increased rapidly and I've now seen, treated and helped over 200 patients, mostly adult females in the 20 to 35 year age range. However, I hasten to point out that patients of any age can suffer from Candida-related illness. Moreover, as Truss has pointed out, males may also suffer from this disorder. However, males appear to develop the Candida problem less frequently because they aren't subject to pregnancy, birth control pills and recurrent urinary tract infections.

Some two years ago, Dr. Robert Owen, an Otolaryngologist of Nashville, Tennessee, who first alerted me to Dr. Truss' work and who subsequently has published a paper on candidiasis and its relationship to human illness, commented, "It seems to me that the prolonged use of broad-spectrum antibiotics in children with recurrent ear troubles may affect their immune systems. Certainly, if broad-spectrum antibiotics stimulate the growth of Candida in adults and such adults develop immune system problems, it's reasonable to suppose that children may also suffer from health problems related to Candida."

In his continuing discussion, Dr. Owen said, in effect, "The problem of recurrent serous otitis media and other related ear problems is one of the most difficult problems facing parents of young children, pediatricians, family physicians and otolaryngologists. Although antibiotics may temporarily control ear infections and the insertion of tubes may help relieve the problem in some patients, the ear disease 'epidemic' continues throughout America."

Parenthetically, at a meeting of the Society for Clinical Ecology in New York, in a presentation entitled, "Serous Otitis: Are Tubes the Answer?," George Shambaugh, M.D. commented: "There is no question of the usefulness of ventilating tubes for O.M.E. They equalize air pressure on both sides of the tympanic membrane thus allowing the fluid to resorb or be expelled by ciliary action through the eustachian tube. The only question is whether O.M.E. can be controlled by means other than surgery."

Dr. Shambaugh then reviewed his experiences in a study of over 100 children with recurrent ear problems and concluded, "...O.M.E. in children is very often, contrary to recent literature, of allergic origin. With allergic management at least seventy-five percent can be controlled without surgery."

I do not know at this time whether putting young children with ear problems who are receiving antibiotics on the Truss program will help lessen the incidence of recurrent ear problems. However, based on my experience in adults, I feel it is a safe and reasonable therapeutic approach to a problem which isn't responding to current medical and surgical management.

Here's more about the possible relationship of antibiotics not only to recurrent ear problems and other health problems in children, but also the possible relationship of antibiotics and Candida colonization to severe mental and nervous system symptoms in children.

In December, 1981, the mother of a 6-year old, Middle-Tennessee child consulted me because of developmental problems experienced by her child. This youngster had been examined by a number of different physicians, including a specialist at a university medical center, and a diagnosis had been made of "pervasive developmental disorder with autistic-type behavior."

Because the child gave a history of persistent rhinitis, recurrent ear problems and therapy with antibiotic drugs, I suspected multiple food allergies and placed him on the "cave man diet" for a period of a week. This diet eliminates any and every food a person eats as often as once a week. Instructions for carrying out the diet are described in detail in the book, **Tracking Down Hidden Food Allergy** (pages 25-38, and 45-55). I

instructed the mother to return the eliminated foods, one food per meal, if and when the child showed a significant improvement in his symptoms lasting 48 hours.

In less than a week, the mother and the child's teachers reported significant improvement.

One of the most intriguing things to me about the child's response was the mother's finding that the greatest reactions came from the addition of mushrooms, yeast and sugar ... all of which caused behavioral symptoms.

And since my experiences with this child, I've been using the Truss anticandida program in treating children with hyperactivity. I emphasize diets free of sugar, yeast and molds. Yet I do not limit the ingestion of complex carbohydrates in children.

Along with this program, I've made a number of other recommendations, including the avoidance of chemicals, the use of appropriate supplemental nutrients, including vitamin C and members of the B-complex (must be derived from a yeast free source). I've also prescribed essential fatty acids in the form of primrose oil. Finally, I've carried out intradermal provocative testing as described by Miller, Rapp, O'Shea and others, and have used sublingual extracts in treating many of these patients.

Most of the hyperactive children I've treated with this comprehensive program have improved. Yet, because of the multiple therapeutic modalities I've used, I haven't yet evaluated the role of Candida in managing these children.

Because of my growing interest in Candida albicans and because of similar interest of many of my peers in the Society for Clinical Ecology, I organized an informal Candida Albicans Conference which was held in Dallas in July, 1982. This conference featured the clinical presentations of Dr. Truss and Dr. Sidney Baker (Head of the Gesell Institute for Human Development) New Haven, Connecticut.

Some fifty physicians and a dozen other participants met together to exchange information informally on the yeast problem.
This meeting enabled those present to form a consensus about the things we do and don't know based both on clinical experience and basic immunology. The entire proceedings of the Conference were recorded by Creative Audio, 8751 Osborne, Highland, Indiana 46322.

Those participating in the conference unanimously agreed that Candida albicans plays an important role in causing chronic illness. And by appropriate recognition and treatment of "the Candida problem," many chronically ill people will improve dramatically.

Yet, in the discussion, most of the participants emphasized that Candida was only one of many, many nutritional, allergic, biochemical, metabolic, environmental and ecological factors that worked together to cause human illness. And if these other factors were not considered and appropriately managed, many patients would fail to improve.

At the conclusion of the conference, Dr. Sidney Baker summarized what he felt to be the consensus of the conference and his own views of the role of Candida in human illness.

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[1] These findings are available from the CSF office, together with a teacher's letter and case report, an abstract of Dr. Sidney Baker's address and several clinical reports of Dr. Crook's patients in whose treatment the anti-yeast program has played a significant role. Please send $1.50 to the CSF office, 2229 Broad St., Regina, Saskatchewan, Canada, S4P 1Y7.

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To the Editor:

Immunological studies carried out at the Tumor Institute of the University of Alabama Medical College over the last year and a half have shown abnormalities in the lymphocyte subpopulations as measured by the monoclonal antibody technique.

Severe depression of natural killer cells, depression of helper cells, and, in many cases, elevation of suppressor cells have characterized the abnormalities most commonly found. In addition, a low total T-cell count, low total B-cell count, and diminished numbers of specific immunoglobulin-bearing B-cells, particularly the IgM cells, have been found. Long-term follow-up studies are underway to determine changes in these abnormalities after treatment of the yeast problem.

The purpose of this letter is to point out these as yet unpublished data because of the urgency of exploring all possible factors that could be related to the Acquired Immune-Deficiency Syndrome. This condition has been widely publicized, and no attempt will be made to discuss the details of its behavior. However, the increasing evidence that this condition is occurring in hemophiliacs, in drug addicts, and in male homosexuals in particular, raises the question as to whether such trauma to the skin and mucus membranes might be allowing entrance into the bloodstream.

Candida exists in many strains. One strain, for example, is known to ferment carbohydrate all the way to ethyl alcohol. If Candida albicans can induce changes such as reported above in the immune system, it seems worthy of consideration in this strange, rapidly increasing, and often fatal
immune-deficiency state. Many potent mycotoxins have been found already, including the "yellow rain" that has allegedly been used in chemical warfare in Afghanistan. The powerful immunosuppressant drug Cyclosporin A, so widely used now in the prevention of the rejection of transplanted organs, is a product of at least two fungi.

Systemic Candida invasion has long been known to be associated with the use of catheters, needles, transfusions, etc. These are the same pre-disposing factors that have been identified in the AIDS problem. Thus Candida albicans seems to be at least one agent capable of at least a depressing, and perhaps a destructive effect on the immune system. Until the cause of the AIDS problem is uncovered, any approach would seem to be worth considering in a situation of such urgency.

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