The Contribution of Refined Carbohydrate Consumption to Maladaptive Behaviors

Diana Fishbein, Ph.D. 1

Abstract

One of the many postulated causes of maladaptive behaviors which is currently receiving much popular interest is the consumption of refined carbohydrates. The relationship between nutrition and behavior has been severely neglected in the scientific arena, although experts have begun to explore the topic in a theoretical and speculative capacity. An overview of the literature that does exist implicates the hypoglycemic syndrome. frequently perpetrated by refined carbohydrate intake, as the culprit responsible for behavior that is dysfunctional to the individual affected. The research project presented herein is one of the first experimental endeavors designed to substantiate this relationship and determine its significance. Conclusions borne out of this research were: first, that further, more in depth research projects should ensue: second, policy strategies should be formulated; and third, scientific, physiological measurements should be an essential ingredient in human research.

Introduction

The human species is among the few creatures on this earth with the ability and proclivity to consciously alter the environment. The development of the neocortex and the resultant "conceptual man" (Reynolds, 1976) led to mankind's manipulation of the natural milieu. In many respects, such change was "functional" to the human; we are a fairly adaptable species and advances in technology and medicine have extended lifespans and have taken us, to some degree, out of the mercy of our environment. In other respects, however, such change served to widen a potentially fatal gap between technological growth and evolutionary growth of the human species (Reynolds, 1976).

As this gap widens, humans become increasingly unable to adapt to the very environment they have created. In order to survive, they must readjust to ever changing conditions. Fortunately, humans are quite versatile and have accommodated the many evolutionary developments. Nevertheless, there are physiological limits on the extent to which accommodations can be made, and mankind is bound to experience failures to readily adapt to every transformation that it engineers. The consequences are many and varied but condense to three general outcomes: reproduction decrease, mortality rate increase, and maladaptive behaviors.

With the abandonment of the notion of "mind" and the advent of scientific inquiry

1. Assistant Professor University of Baltimore North Charles at Mt. Royal Baltimore. Maryland 21201

into the "brain", researchers are becoming more adept at detecting environmental factors which produce maladaptive behaviors. Exposure to particular substances, many of which we have manufactured or modified, can trigger neural disorders that, in turn, produce disordered behavioral patterns (Pauling, 1968; Monroe, 1970; Carlson, 1977; Schauss, Oct. 1978). Not only is such behavior malfunctional to the individual affected in terms of comfort, reproduction and survival, it also disrupts the maintenance of peaceful coexistence between individuals of the species.

Man's body evolved in harmony with the "naked" environment and the materials in that setting were whole and unrefined. Once the composition of materials vital to man's existence are modified, man's body will either readapt or, if unable, maladapt. For these reasons, researchers find it important to isolate the particularly damaging factors contributing to maladaptive disorders in an effort to eventually employ appropriate preventative measures.

The hypothesis presented here to be scrutinized and tested is that refined carbohydrate consumption is a significant contributor to maladaptive behaviors. Recent inquiry into this subject has rendered much description and theoretical analyses, although scientific research is virtually nonexistent. Evidence of this relationship is discussed herein in terms of physiological bases and behavioral correlates, and the scientific endeavor to measure the strength of the kinship is described.

Physio-Metabolic Processes

In order to appreciate the recent evidence concerning the relationship between refined carbohydrates and behavior, it is important to understand the metabolic process of carbbohydrate consumption and hypoglycemia. Very briefly, carbohydrates are ingested and broken down slowly into glucose within the intestine. As the glucose is absorbed into the bloodstream, the pancreas registers a rise in blood glucose levels and secretes insulin. Insulin facilitates the entry of glucose into the cells for usage and stores the excess as glycogen or fat. The central nervous system, in turn, perceives a drop in blood glucose and stimulates the release of epinephrine, somatotrophic hormone, and glucagon while it activates the liver's sympathetic fibers. Thus, the stored reserves are retrieved, the cells of the body and the brain are replenished with glucose supplies, and metabolic homeostatis is maintained.

It becomes apparent in an examination of carbohydrate metabolism, that glucose is essential to the efficient operation of the brain and nervous system. When metabolic disorders develop, blood glucose levels may decline below the safety limit and the brain perceives a crisis. Without fuel for energy, the brain begins to malfunction. Malfunctions of this nature invariably create irregular physiological reactions consequently manifested as disordered behavioral patterns. Moreover, factors that have promulgated the behavior may go undetected, as metabolic problems frequently do. Persons with a particular susceptibility to metabolic disorders may suffer an unusual and many times, uncomfortable reaction to the ingestion of refined carbohydrates.

Hypoglycemia is typified by a chronic low blood glucose condition induced by the continual compulsion to indulge in a diet of refined carbohydrates. This type of idiopathic, reactive hypoglycemia is thus distinguished by its sole causative agent; diet. Attention is drawn to refined carbohydrates and sugars due to pervasive dependency on these substances in western cultures and their exceptional potential for contributing to hypoglycemia. Other effects of a diet consisting primarily of refined carbohydrates are vitamin deficiencies, allergies, malnutrition, and diabetes. These conditions all interact with the hypoglycemic syndrome either by abetting its onset or by acting as concomitants of the syndrome. This interactional effect may be attributed to the molecular composition of refined carbohydrates and the resultant difficulties incurred with their uptake, and the associated shortage of vitamins and nutrients that refined carbohydrates generally contain. Thus, hypoglycemia is necessarily discussed in conjunction with refined carbohydrate consumption. Carbohydrates, found naturally in the

environment and ingested for their nutritional value, are included among the substances that have been chemically altered by man (Shallenberger and Birth, 1975). Eventually, all carbohydrates are converted by the digestive fluids into glucose to be used for energy, principally by the brain. As glucose is absorbed into the bloodstream it provides a constant supply to be expended as needed. Thus, assuming the body maintains the functions and processes of proper metabolism, the "natural refinery" within the body will break down the carbohydrates for use at an optimal rate.

Carbohydrates have been artificially refined by man to produce a substance of simple molecular composition. When consumed, these refined carbohydrates are easily digested, not requiring the operation of prolonged enzymatic action. The natural refinery of the body is bypassed and the "predigested substances", converted rapidly into glucose within the intestine, enter the bloodstream too swiftly for the metabolic mechanisms to process. The rate of entry causes the regulatory mechanisms, such as the pituitary, adrenal and pancreatic responses, to experience immediate and excessive demands to maintain an equilibrium. The body, unable to handle the stress of rapidly rising blood glucose levels, or 'sugar shock', loses its once carefully balanced homeostasis as adaptive operations become severely hindered. Accordingly, the brain's ability to perform is impaired and the behavioral product is modified.

Behavioral Correlates

Behaviors elicited by refined carbohydrate consumption via hypoglycemia generally include unacceptable aggression (Yaryura-Tobias, 1973 and 1978), learning disabilities (Tarnopol, 1969; Bresler, 1975; Ferren-delli, 1975; Powers, 1975; Carlson, 1977), hyperactivity (Tarnopol, 1969; Sugarman and Stone, 1974; Moyer, 1975), and criminality (Reed, 1977; Hoffer, 1978; Schauss, 1978). Although adaptive behaviors may also result, the studies cited above seem to indicate that the probability of maladaptive behavior is much greater. When a diet high in refined carbohydrates is accompanied by an inadequate environment, the probability of a maladaptive outcome increases all the more. Other variables which may contribute to this interactional effect include self concept, parental situation, labeling, opportunity, socio-economic status, education, peer group, prenatal care, inherited characteristics, and many other environmental, psychosocial and organismic circumstances. Hence, refined carbohydrate consumption is hypothesized to be a significant, but not a sufficient, inducement of maladaption.

The actual symptoms and severity of hypoglycemic tendencies associated with refined carbohydrate consumption vary among individuals. Cooper and Pfeiffer (1977) have enumerated the following effects; fatigue, irritability, nervousness, depression, vertigo, faintness, insomnia, mental confusion, inability to concentrate, anxiety, phobias, dysperceptions, destructive outbursts, headaches, heart palpitations, muscle cramps, convulsions, digestive disturbances, allergies, blurred vision, lack of sex drive in women, impotency in men, and difficulty in performing simple physical and mental tasks.

Low blood glucose levels accompany nervous system disorders when messages to the brain are not transmitted correctly and mental processing of information becomes erratic. The result is schizophrenic symptoms. Experiments administering the MMPI to correlate personality disorders with hypoglycemics reveal a considerably high percentage of abnormal personality profiles (Anthony, 1973). Personality patterns differed from those of healthy persons, diabetics, and those with other endocrine disorders, which suggest a relationship between hypoglycemia and a particular personality pattern.

Professor Moyer of Carnegie-Mellon University describes aggressive behavioral responses due to hypoglycemia (1971). Anxiety, depression and impulsiveness are frequent, while aggressiveness and irritability are also common. The individual may become rude and profane and express rage. When the condition worsens, the sufferer becomes confused and disoriented. He/she may wander aimlessly, engaging in irrational

and sometimes violent behaviors.

Review of numerous literature sources indicates that research in this area may have far-reaching ramifications for the field of criminology. In studying the etiology of criminal behaviors, such explorations may contribute to the understanding of alcohol and drug related criminality, female anti-sociality, motiveless crimes, violence, schizophrenia, the statistical concentration of lower class criminality, and learning disorders that may instigate future criminal activities.[1] In terms of policy formulations knowledge extracted from this research may assist in the treatment of offenders, psychiatric patients, juvenile delinquents and problem children. In addition, substance abusers may benefit by new treatment approaches based on findings in this area. Investigation of this theory could culminate in revised court actions, legislative movements, rehabilitative techniques, and public education.[2]

Methodology

In order to measure the postulated causal relationship, a four-group experimental design was employed. The sample population was comprised of male inmates at the Lantana Correctional Institution. They were all between the ages of 16 and 28 and had been convicted of a variety of offenses. Their placement at LNCI was based on evidence of drug dependencies. They were informed of the procedures and all possible benefits or detriments which may be incurred. They did not, however, know of the specific purpose for the research, what results were expected, and why experimental manipulations were imposed. After eliminations were made due to medical and release-date reasons, 104 volunteer inmates remained for the duration of the project.

The sample population completed a Symptomology Exam and a Food Frequency Questionnaire. The Symptomology Exam was derived primarily from Reed's (1977) extensive list of symptoms associated with hypoglycemia.[3] Reed noted that individuals recording more than 25 symptoms generally obtained a positive glucose tolerance test; indicative of hypoglycemia. The Food Frequency Questionnaire provides a quantitative measure of foods ingested or preferred by the subjects. Accordingly, those subjects who had previously maintained a high refined carbohydrate diet were distinguished from those who did not."

The scores achieved by each subject on both exams were tabulated to render an individualized mean score. This mean served as the basis for initial group assignments; high scorers assigned to the "hypoglycemic" group and low scorers assigned to the "non-hypoglycemic" group.[5] Both groups were then further subdivided in a random manner into control and experimental groups, yielding four groups in toto.

Maladaptive behaviors were quantitatively measured by the Hoffer-Osmond Diagnostic Test. This test was originally developed to diagnose schizophrenia and is used to quantify mental illness. It is "handy, reliable, simple, well-received by patients, gives one a rough and ready picture of the patients' experience, and takes a short time to administer and to score." (Osmond, 1975). This test is not affected by intelligence; it measures learning disabilities without the confounding influence of inborn intellect. It does not attempt to measure aspects of the personality, and it is reasonably free of cultural biases.

The HOD Test is structured to survey and assess the range of sensory perceptions and mood changes. The results produce six scores: Total Score, Perceptual Score, Paranoid Score, Depression Score, Thought Disorder Score and Ratio Score. Each of these scales is highly applicable to the design at hand in terms of degrees of maladaption; the six scores obtained from the HOD pertain to a range of disorders produced by excessive refined carbohydrate consumption.

Subsequent to group assignments, subjects were instructed to complete the HOD Test and again a score was achieved, furnishing a quantitative measure of maladaptive behaviors. Experimental manipulations were initiated at this time and consisted of a special meal program administered to the experimental groups for a duration of one month. Homeostatic effects generated

from a change in diet occur within two weeks on the average. This meal plan was specifically designed for the treatment of hypoglycemia with the assistance of a nutritionist, dietician and numerous literature resources. Particular emphasis was placed on the restriction of refined carbohydrates, not to exceed five percent, and the increased intake of the more complex carbohydrates. In persons with hypoglycemic tendencies, refined carbohydrates cause a spiking of blood glucose levels followed by a sharp drop below safety levels. This meal program was formulated to achieve an even level of blood glucose throughout the day. All food substances were carefully monitored during this period.

At the end of the one month period, the subjects were again assessed for behavioral disturbances using the HOD Test. The researcher expected differences to emerge between the four groups. Assuming that the inherent and superimposed controls were adequate, this finding would indicate that manipulation of the diet contributed to any cessation, decrease, or increase in behavioral problems. Specifically, it was predicted that the experimental group which had previously maintained a high refined carbohydrate diet with an excessive number of hypoglycemic symptoms would show relatively greater improvement as evidenced by comparatively low HOD scores.

Data Analyses

A positive correlation was noted between categorical exam scores and HOD pretest scores. Pearson's R coefficients evidenced a strong positive correlation between these measures, with each coefficient significant at the .00001 level. The highest positive correlation was achieved for the Depression Scale with an R^2 = 63628. The lowest correlation was R^2= 19934 obtained for the Paranoid Scale. Support for the reliability of the instruments is thus reinforced by strong correlations between high and low scores.

A computation of mean scores for each HOD scale was completed for both pretests and post-tests. Comparisons between these two sets of mean scores disclose radical differences between the two independent measurements obtained from the Experi-mental-Hypoglycemic (EH) group with a relatively small variation in scores for the remaining groups. The EH group experienced a 44 percent decrease in HOD scores following the meal program, while the other three groups indicated 14 percent, 15 percent and 16 percent decreases. Using a one-way analysis of variance, differences between groups were assessed to determine relative pretest and post-test changes on the HOD scales, as seen in Table 1. Statements formulated from these statistics indicate the degree to which the EH group diverges from the other three groups and the percentage of pretest and post-test variations within a particular scale that can be attributed to the imputed properties of EH subjects. The EH group obtained significantly different scores on HOD post-test scales in most instances. The Total Score scale, Depression Scale, Perceptual Scale and Short Form show substantial differences in changes incurred by the EH group as compared with the other three groups.

TABLE 1
ANOVA TABLES

	F-Ratio	Significance	ETA SQRD
Total Score Scale	6.4197	.0005	.1615
Perceptual Scale	6.4392	.0005	.1619
Paranoid Scale	1.6671	.1789	.0476
Depression Scale	8.4277	.0000	.2018
Ratio Scale	2.4928	.0644	.0696
Short Form	2.8450	.0415	.0786

An extensive multivariate analysis of variance was produced by the "Manova" SPSS procedure. Again, the EH group was compared with the remaining groups to locate significant changes in HOD scores for each scale. Several multivariate tests of significance suggest that there are substantial differences in changes incurred by the EH group as distinguished from the other three groups. Pillais, Hotellings, and Wilks tests of significance show significant differences in EH group scores relative to the others at the .005 alpha level, as depicted in Table 2.

In order to enhance the results of the t-difference tests, tests of hypotheses and corresponding confidence intervals were examined. Overall, the data indicated that the EH group means fall outside the confidence in-tervals for all HOD scales, inferring that those group mean scores are unusual or unlikely. The remaining groups, in most instances, possessed means within corresponding sample confidence intervals. These sample confidence intervals were relatively narrow so that one can be reasonably assured that conclusions derived are accurate.

TABLE 2
MULTIVARIATE TESTS OF SIGNIFICANCE

Test Name	Value	Approx. F.	Significance of F.
Pillais	.38484	2.37907	.00151
Hotellings	.49461	2.57381	.00056
Wilks	.64777	2.48151	.00093

Univariate F-tests that were produced testified that substantial changes were accrued by the EH group on the Total Score scale, Perceptual Scale, Depression Scale and Short Form. This finding corresponds with the ANOVA results described previously.

An averaged F-test for a combination of the HOD scales produced an F equal to 5.66831 with a significance level of .00001. This statistic indicates that, in general, the EH group differs substantially from the other groups in terms of pretest and post-test changes incurred.

Further analyses of the data were performed with t-difference tests. Differences between pretest and post-test scores for each scale were calculated in order to arrive at a significance test of total differences for the four independent groups. Again, the EH group differed in most instances from the others. For the Total Score scale, with a .0005 level of significance, the EH group showed greater differences between pretest and post-test scores. The same holds true for all HOD scales with the exception of the Depression Scale; the control-hypoglycemic (CH) group also showed significant changes on the Depression Scale. (As a table of t-statistics is lengthy, it is not delineated herein.)

Supplementary *to* the preceding data analyses, a paired comparisons analysis for each HOD scale using gain scores was performed. The Tukey and Scheffe methods were employed *to* prevent Type 1 error from becoming excessively large. These results yield the difference between two group treatment means.

Pooled Variance Estimates, produced by the paired comparisons procedure, are shown in Table 3 for each HOD scale. Contrasts 2, 4, and 6 compare the EH group with each of the other groups. The F-ratio for each HOD scale was significant at the .05 level with the exceptions of the Paranoid Scale and the Ratio Scale. This finding corresponds with the results of the aforementioned univariate tests. The EH group was found to be the source of most of the variation, while the other three groups did not significantly differ from one another on most measures.

TABLE 3
POOLED VARIANCE ESTIMATES

Total Score	T Value	T Prob.
CONTRAST 1	-3614	.719 .001 .057
CONTRAST 2	-3.5880	
CONTRAST 3	1.9292	

CONTRAST 4	-2.0206	.046
CONTRAST 5	-1.7580	.082
CONTRAST 6	-3.7291	.000

Perceptual Scale

	T Value	TProb.
CONTRAST 1	-5.622	.575
CONTRAST 2	-3.4549	.001
CONTRAST 3	1.7569	.082
CONTRAST 4	-2.2581	.026
CONTRAST 5	-1.7871	.077
CONTRAST 6	-3.8166	.000

Paranoid Scale

	T Value	TProb.
CONTRAST 1	.5644	.574
CONTRAST 2	-1.9255	.057
CONTRAST 3	1.8942	.061
CONTRAST 4	.4602	.646
CONTRAST 5	-.1402	.889
CONTRAST 6	-1.2019	.232

Depression Scale

	T Value	TProb.
CONTRAST 1	.8825	.380
CONTRAST 2	-4.1929	.000
CONTRAST 3	.2877	.774
CONTRAST 4	-2.7126	.008
CONTRAST 5	-3.8937	.000
CONTRAST 6	-2.9826	.004

Ratio Scale

	T Value	TProb.
CONTRAST 1	-.6429	.522
CONTRAST 2	2.2025	.030
CONTRAST 3	.1348	.893
CONTRAST 4	1.4868	.140
CONTRAST 5	2.3127	.023
CONTRAST 6	1.3778	.171

Short Form

	T Value	TProb.
CONTRAST 1	-1.1248	.263
CONTRAST 2	-1.7472	.084
CONTRAST 3	1.7760	.079
CONTRAST 4	-1.2469	.215
CONTRAST 5	-.0737	.941
CONTRAST 6	-2.8159	.006

Conclusions and Discussion

Personal contacts with the inmates immediately following the post-tests rendered some possibly substantiating testimonies. Without knowledge of the significance of their group assignments, the experimental subjects confronting the researcher invariably declared that dietary changes induced perceptible physical and psychological deviations. Subjects reported mild discomforts during the first two weeks of the experimental diet. Symptoms that were commonly mentioned were abdominal cramps, excessive sweating, exhaustion, dizziness, extreme hunger, irritability and nervousness. Many stated that these physiological results were reminiscent of drug-induced conditions.

In terms of hard data, the results strongly support the original contention that refined carbohydrate consumption contributes to maladaptive behaviors. Pretest and post-test changes in EH group scores on the Perceptual Scale, Total Score scale, and the Short Form were consistently found. The strength of these results, utilizing primarily paper and pencil tests, lends support for the prospect that, with the use of physiological measures, the data may bear out an even greater relationship. As it stands, this experiment offers substantial evidence for the relationship between variables, and leads to the conclusion that further experimental scientific studies should ensue. Hence, emergent policy undertakings would have indisputable scientific foundations.

The general conclusions derived from this project are basically criticisms directed at the pervasive acceptance of paper and pencil techniques as scientific. Further condemnation is directed at the statistical procedures commonly used in the exploration of human behavior. The dubious nature of the results, which preclude formulation of conclusive statements, stems from the tentative validity and reliability of such measurements as employed in human experimentation. This harsh observation was arrived at from the investigator's direct experiences in executing this project.

The human is tremendously unpredictable and complex and cannot be studied as a group since such study tends to obscure individual differences. Unique beings must be examined as individuals to account for omnipresent variation. Moreover, the human must be examined with instruments that are attuned to his/her complexities:

although statistical analyses enable one to estimate the relative significance of a variable's impact on a population, they do not provide insight into an individual's specific problems or remedies. Additional information that lends itself to inferential statements can be exacted by the involvement of time series analyses. The desired result is tangible, concrete data which demonstrate the constantly evolving condition typifying our species.

The institution of scientific physiological measurements as a necessary ingredient in human research should reduce the inevitability of unmanageable amounts of investigator bias interjected into the data base. Physiological measures do not require an excessive degree of human input during the actual measurement process, but caution must be exerted in the interpretations of all forms of data. This is not to assert that statistical analyses and sociological or psychological exams should be discarded. They should, instead, serve to supplement the analysis, preferably in a subordinate role.

Review of this undertaking presented herein induced the researcher to critically examine not only the data, but also the methodologies used in this project and in human research generally. Thus, the indication of a strong relationship between refined carbohydrate consumption and maladaptive behaviors is sufficiently supported to warrant acceptance of the idea that dietary factors influence human behavior. This study does not stand alone in suggesting a nutrition-behavior association, but it demands uncontestable ratification.

The implications of this study will not be explored in this article, although an extensive policy analysis can be found in the author's Master's Thesis. Findings in this area have clear implications for early diagnosis, prevention, and treatment of such behavioral disorders. It costs the taxpayers of this nation $20,000 to $40,000 a year to incarcerate a single offender, along with a multitude of other social and psychological costs. An alternative to institutionalization is needed, and further research on human behavior is the only way in which this can be accomplished.

Notes

(1) For further information and research endeavors, refer to the following materials: D'Asaro, 1973 and 1974; Hoffer, 1975; Haworth, 1976; Hoffer, 1976; Schauss, 1978; Worden, 1978; Anon, 1979; First, 1979; Gottlieb, 1979; Schauss, 1979; Yates, 1979.

(2) For further modifications in legal status and treatment which incorporate recent findings on hypoglycemia, refer to the following materials:McClay, 1977; Schauss, 1978; Gottlieb, 1979; Lyle, 1979.

(3) With this correlation in mind, 25 or more symptoms were presumed indicative of hypoglycemia or a tendency towards it.

(4) A high refined carbohydrate diet was implicated by an everyday diet in excess of 5 percent refined carbohydrate content. Scores on this evaluation were weighted according to the subject's weight and age.

(5) Cut-off points were previously established according to principles defined in (3) and (4) above. Use of the terms "hypoglycemic" and "nonhypoglycemic" are indicative, not definitive.

(6) Sugar-Induced Hypoglycemia is a Significant Contributor to Maladaptive Behavior. Diana Fishbein. Florida State University Library, 1978.

Acknowledgement

My thanks to the American Association of University Women for financial and personal support.

References

ANTHONY. D. et al.: Personality Disorder and Reactive Hypoglycemia. Diabetes 22. 9. 664-675. 1973.

BRESLER, D., ELLISON, G. and ZAMENHOF, S.: Learning Deficits in Rats with Malnourished Grandmothers. Developmental Psychobiology 8, 4, 315-323. 1975.

CARLSON, N.: Physiology of Behavior. Boston: Allyn and Bacon, Inc., 1977.

COOPER, A. and PFEIFFER, C: Functional Hypoglycemia: Ubiquitous Malady. Princeton, New Jersey, Brain Bio Center, 3, 1977.

FERRENDELLI, J.A.: Hypoglycemia and the Central Nervous System. In: Inquar, D.H., Lassen. N.A.: Brain Work. Munksgaard, Copenhagen, 1975.

HOFFER, A. and WALKER, M.: Orthomolecular Nutrition. Connecticut, Keats Publishing, 1978.

MONROE, R.R.: Episodic Behavioral Disorders. Cambridge, Harvard University Press, 1970.

MOYER, K.: Physiology of Hostility. Chicago, Markham Publishing Co., 1971.

MOYER, K.: Physiology of Violence, Allergy and Aggression. Psychology Today, V, 9, 76-77, 1975.

OSMOND, H., HOFFER, A. and KELM, H.: The Hoffer-Osmond Diagnostic Test. New York, Krieger Publishing Company, 1975.

PAULING, L.: Orthomolecular Psychiatry. Science Magazine V, 160, 265-271, 1968.

POWERS, H. Jr.: Caffeine, Behavior, and the LD Child. Academic Therapy V, 11, 1, 5-19, 1975.

REED, B.J.: Back to the Basics. Ohio, Municipal Court of Cuyahoga Falls, 1977.

REYNOLDS, V.: The Biology of Human Action. San Francisco, W.H. Freeman and Company, 1976.

SCHAUSS, A.: Body Chemistry and Offender Behavior, Correctional Training Personnel V, 3, 3, 1-3, 1978.

SCHAUSS, A.: Orthomolecular Treatment of Criminal Offenders. Washington, Abstract; Washington State Criminal Justice Training Commission, Oct., 1978.

SHALLENBERGER, A. and BIRTH, A.: Sugar Chemistry. Connecticut, Avi Publishing Co., Inc., 1975.

SUGARMAN, A. and STONE, I.: Your Hyperactive Child. Chicago, Henry Regnery Co., 1974.

TARNOPOL, L.: Learning Disabilities. Illinois, C.C. Thomas. 1969.

YARYURA-TOBIAS. J.: The Behavioral-Gluco-Dysrhythmic Triad. American Journal of Psych. V, 130, 7, 1973.

YARYURA-TOBIAS, J. and NEZIROGLU, F.: Compulsion. Aggression, and Self Mutilation: A Hypothalamic Disorder? Journal Orthomolecular Psych. 7,2,114-117, 1978.