DIET, CRIME AND DELINQUENCY: A CRITIQUE

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In the past several years, theories relating diet to antisocial behavior have become more widespread. Once relegated to books and articles aimed at food faddists, such theories are now discussed at meetings of criminologists and are found in books and articles aimed at personnel in the correction and criminal justice systems.[1-7] In response to these theories, correctional facilities in several states have changed the diets fed to inmates, provided megavitamin supplements, and begun testing for hypoglycemia, food allergies and "subclinical" nutritional deficiencies.[1,5-8]

Until recently, these theories and the changes taking place in correctional facilities had been largely ignored by nutrition researchers, dietitians and others in the medical community. As a result of statements by the American Council on Science and Health, the American Psychiatric Association Commission on Psychiatric Therapies, the California Council Against Health Fraud, and the California Medical Association, these theories are beginning to be examined more critically.

Theories Relating Diet to Crime

Advocates of a link between diet and crime do not agree upon a single mechanism by which diet influences behavior. Reactive hypoglycemia; food allergies; other adverse reactions to food additives, sugar and milk; and "subclinical pellagra" and other vitamin and mineral deficiencies and toxicities have all been given as explanations for a relationship between diet and antisocial behavior.[1-10] The evidence for each of these theories was reviewed previously and found lacking.[11] In general, most claims were based on anecdotes. Where claims were made regarding a high prevalence of food allergies, hypoglycemia or mineral deficiencies or toxicities among prisoners or juvenile delinquents, the techniques used to make the diagnoses were typically highly unreliable;[11-14] no figures were given for comparable control groups. Studies done to assess the effects of dietary change on the behavior of criminals and delinquents were not of the randomized, controlled, double-blind variety used in most clinical research, but were instead poorly designed, and subject to numerous biases and much confounding of effects.[11]

Since the publication of the earlier review,[11] new research has been reported related to hypoglycemia and the effects of dietary carbohydrates on violence and antisocial behavior. This research will be reviewed here in more detail.

Hypoglycemia and Violence

Earlier claims that reactive hypoglycemia was common in criminals and delinquents either presented no data, used questionnaires rather than an oral glucose tolerance test (OGTT) to make the diagnosis, or did not use standard criteria for evaluating the results of the OGTT.[11]

Virkkunen [15-17] has subsequently performed OGTTs on a number of habitually violent offenders, as well as on controls. Those violent offenders who had a diagnosis of antisocial personality disorder or intermittent explosive disorder were found to have significantly lower serum glucose nadirs than either controls or violent offenders without either diagnosis. Virkkunen[16] has subsequently speculated that en-

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hanced insulin secretion is responsible for violent behavior, especially when these subjects consume alcohol, because alcohol also potentiates insulin secretion. Virkkunen's results have been taken by some to imply that violent behavior is a result of enhanced insulin secretion and reactive hypoglycemia. Such an interpretation appears unwarranted for several reasons.

First, it is well recognized that the OGTT is an unphysiologic test. Blood glucose levels in normal subjects are lower (and insulin secretion higher) during the OGTT than following a meal containing the same amount of carbohydrate.[13] Thus, the finding that individuals with an antisocial personality disorder or intermittent explosive disorder have significantly lower glucose levels during an OGTT does not imply that this occurs following meals.

Second, while certain violent individuals were noted to have low glucose levels during the OGTT, no mention was made of symptoms occurring after meals or during the OGTT. Hence, a diagnosis of reactive hypoglycemia cannot be made.[11]

Finally, and most importantly, no mention has been made of violent behavior occurring during the OGTT at the time of the glucose nadir or insulin peak. Without such evidence, one cannot conclude that either the low blood glucose level or increased insulin secretion is responsible for violent behavior.

There is evidence that genetic factors may be involved in the antisocial personality disorder,[16,18] and it is likely these genetic factors are responsible for both the behavioral and metabolic manifestations. While there may be an association between antisocial personality disorder and an abnormal glucose tolerance test, it is more likely because of a common underlying genetic basis than as a result of the behavior being directly caused by the subtle metabolic abnormalities.

Dietary Intervention Studies

Schoenthaler[6,7,19-22] has published a series of studies that involved changing the diets of inmates in juvenile detention facilities. With one exception,[22] these dietary changes involved replacing sugar with honey, soft drinks and Kool-Aid® with fruit juice, and "high-sugar" cereals, desserts and snacks with foods thought by the investigator to be lower in simple sugars (e.g., fruit and peanut butter). Using the institutions' disciplinary records as the dependent variable, Schoenthaler[7] has claimed that these dietary changes decreased antisocial behavior by 21 to 54 percent.

Several flaws in the experimental designs make these studies difficult to interpret. First, no quantitative information has been presented concerning the nature of the dietary changes. For example, how big a change in the intake of simple sugars occurred by replacing sugar with honey, Kool-Aid® with fruit juice, and desserts with fruit? Although it is claimed that these dietary changes dramatically decreased the intake of simple sugars, there is no evidence to substantiate this. Such information is crucial to the interpretation of these studies, and unfortunately is lacking.

A second issue is the nature of the dependent variable. Schoenthaler has relied on the facilities' records of disciplinary actions to assess changes in antisocial behavior. It is known that in many institutions, the staff have the discretion to record or not record an incident,[6] and variation over time in the proportion of incidents recorded may lead to erroneous results.[11]

Because these studies were not double-blind, despite an earlier claim by Schoenthaler,[6] a variety of nonspecific factors may have been responsible for the positive results claimed.[11,23,24] Because the observers were often aware of the nature of the study, their observations may have been influenced by their expectations, a phenomenon known as observer bias. Because the staff was generally aware of the nature of the study, their interactions with the subjects may have changed and could have produced changes in the subjects' behavior, a phenomenon known as the experimenter expectancy or Pygmalion effect. The subjects' awareness of the dietary changes may have produced placebo effects. Also, simply knowing they were in a study could have caused the subjects to improve their behavior, a phenomenon known as the Hawthorne effect.

Finally, there are serious questions regarding the control groups and the methods of sta-

tistical analysis, issues which will be addressed in conjunction with the discussion of the individual studies.

Schoenthaler's first study,[6] conducted in a juvenile detention facility in Virginia, compared the disciplinary records of 102 juveniles in the facility during the year before a change in diet took place with those of 174 juveniles in the facility after the change took place. The number of disciplinary actions per person per day decreased from 0.29 to 0.15 ($p < 0.0001$). Concurrent with the proposed dietary changes, a number of changes in the composition of the inmate population took place: the percentage of nonwhite inmates decreased from 31 percent to 18 percent; the percentage of females increased from 0 percent to 29 percent and the percentage of inmates outside ages 13 to 16 increased from 3 percent to 18 percent. These changes were all in the direction that should lead to a decrease in the number of reported incidents. While Schoenthaler attempted to control for each variable separately and demonstrated that the differences between dietary groups remained, he never controlled for all three demographic variables simultaneously. Hence, from this study one cannot determine whether the effects were due to dietary changes, changes in the inmate population, changes in the recording of incidents, or a variety of nonspecific effects.

A second study[21] with a similar design was done in Stanislaus County, California, and involved studying the reports on 884 males in the facility the year before the dietary change took place, and the reports on 1,121 males in the facility during the year after the change took place. The mean number of reported incidents per male per day decreased from 0.036 to 0.028, a difference that was not statistically significant (2-sided, $p = 0.06$). No difference was found among the total of 573 females studied during the two periods.

A third study,[19] again with a similar design, was done in a juvenile facility in Alabama. Records were compared for three groups: 166 juveniles in the facility during the 6 months before the dietary change took place, 180 juveniles in the facility during the 10 months after the change took place and 107 juveniles in the facility during the 6 months after the regular diet was again resumed. The mean number of reported incidents per person per day was 0.040, 0.039 and 0.061 during the three periods. Proper analysis of the data would have used analysis of variance to determine whether any of the three groups had a different mean than the other groups. Instead, Schoenthaler reported results of tests of differences of means taken two at a time. He found no statistically significant difference between the first baseline group and the experimental group, but did report a statistically significant difference between the experimental and return-to-baseline group (2-sided, $p = 0.02$). It would appear from the data presented that a statistically significant result would not have been obtained if proper statistical methods had been used.

Schoenthaler's study[20] of Los Angeles County, California, juvenile facilities used a different design. He identified 1,382 juveniles who were in juvenile halls on April 1, 1981, the date a change in diet took place. These juveniles were in the facilities for an average of 30 days before and 32 days after the dietary change took place. A decrease in the number of incidents from 0.004 to 0.002 per person per day was found. Schoenthaler concluded that this decrease was due to the change in diet. It is obvious, however, that the results were confounded by the fact that he compared behavior during the first and last portions of the subjects' stay in juvenile hall. One would expect that the number of reported incidents would decrease as the juveniles either learned the rules or learned not to get caught.

Schoenthaler[20] also reported on individuals in three Los Angeles County juvenile detention camps and found no significant change in the number of incidents after the dietary change. However, he subsequently noted that the behavior of the juveniles in the camp improved during the first 6 months and then worsened. He attributed the improvement to diet and the worsening to nondietary factors, eliminated data showing worsening of behavior, and then claimed a "significant" dietary effect. It should be obvious that such ex post facto deletion of data that do not conform to one's hypothesis is not statistically legitimate.

Finally, Schoenthaler[22] reported on an inter-

esting study from a juvenile facility in a mid-Atlantic state that was already feeding inmates a diet claimed to be low in simple sugars. In this study, he compared records of 239 juveniles in the facility during a 6-month period in which milk and water were the only beverages served with meals, with the records of 242 juveniles in the facility during a 6-month period in which orange juice was also offered with meals. No change in milk consumption was noted between the two periods, so the major change was a substitution of orange juice for water as mealtime beverage. The number of incidents per person per day decreased from 0.030 to 0.016 (2-sided, $p = 0.03$). Because orange juice is a source of simple sugars, this latter study would imply that adding simple sugars to the diet may decrease the amount of antisocial behavior.

Taken as a whole, these studies by Schoenthaler [6,7,19-22] do not provide convincing evidence for the claim that simple sugars contribute to antisocial behavior. These studies are marred by faulty experimental design and poor statistical analysis and leave open the question of whether nonspecific factors were responsible for the inconsistent effects he attributed to diet. Closer inspection of the data reveals marked inconsistencies between Schoenthaler's claim[7] of uniformly successful results and the actual results, due in part to the questionable statistical methods used in his initial data analysis. Furthermore, because one study suggested that increasing simple sugar consumption decreased antisocial behavior while the other studies suggested that reducing simple sugar intake had the same effect, it is possible that any improvement seen was due to nonspecific, nondietary factors.

Social Implications

As noted above, several organizations of physicians, dietitians, researchers and health educators have, in the last two years, become increasingly concerned about the implementation of dietary intervention programs in correctional facilities. One reason for this is the concern that politicians and corrections officials appear to be giving more credence to anecdotes and uncontrolled studies than they are to the results of reputable research.[25] There is concern that food faddism is becoming the official policy of correctional facilities.[26] Rather than funding research to determine whether a link between diet and crime actually exists, the dietary beliefs of a vocal minority are made public policy.

A second reason for concern is that there is an increasingly widespread misconception that diet, rather than the individual, is responsible for aberrant behavior. Telling children that their diet is responsible for misbehavior relieves them of responsibility for their actions, does not promote self-control, and may have far-reaching implications in terms of moral development.[11,27]

The belief that diet has a major influence on criminal behavior has already made its way into the courtroom. The most famous example of this was the "Twinkie defense" in the Dan White murder trial.[28] Dan White was a former San Francisco supervisor who went to the city hall with a loaded gun, climbed through a window to avoid a metal detector, and then killed both Mayor George Moscone and Supervisor Harvey Milk. On the surface, this appeared to be a clear case of premeditated murder, but White's attorney used a diminished capacity defense to argue that White's ability to "maturely and meaningfully" reflect on the gravity and evil of the offense was impaired as a result of depression and that "White's penchant for wolfing down junk food—Twinkies, Cokes, doughnuts, and candy bars . . . exacerbated his depression and indicated a chemical imbalance in the brain."[28] As a result, White was convicted of manslaughter, creating a public controversy that subsequently led to the abolition of the diminished capacity defense in California. California has not been the only state in which evidence relating to diet has been introduced into the courtroom, though. A Virginia man was acquitted of burglary after his defense attorney argued that he had committed the crime because of a vitamin deficiency.[26] One advocate of hypoglycemia as a cause of crime wrote to John Hinckley and Hinckley's parents and attorneys, suggesting that hypoglycemia be incorporated into Hinckley's legal defense.[26,29] One can expect an increasing number of defendants to incorporate theories about diet and crime into dimin-

ished capacity defenses in the future.

A third reason for concern is the diversion of resources from effective programs.[11,26] Elected and criminal justice officials in some parts of the country have become so convinced of the validity of a diet-crime link that they have been distracted from more promising rehabilitation concepts.[26] In addition, some programs spend fairly large sums of money testing for food allergies, hypoglycemia, etc.—money that could be better spent elsewhere.[11]

An additional example of misspent public funds has been the funding of poorly designed research. The study by Schoenthaler[20] in Los Angeles County was funded in part by the County. As noted above, the study was methodologically flawed and could not provide a decisive answer to the question asked. Hence, the money for the study would have been more effectively spent had it been used to fund a better-designed study. Similar examples of government funds wasted on poorly designed studies of diet and crime can be found elsewhere.[26]

Research Needs

The principal research need in the area of diet and crime at the present time is the study of the effectiveness of dietary intervention programs. However, any future studies must have a more adequate experimental design than previous studies, and must incorporate several important features.

First, the nature of the dietary change must be specified, either in advance or as a result of determining the food intakes of participants. It is important to know exactly what changes in nutrient intakes took place as a result of the intervention. This has not previously been adequately specified.

Second, it is necessary to specify in advance which behaviors will be observed, both how they will be measured and by whom, and how the results will be recorded. The use of existing institutional records is not adequate for research purposes.

Third, an attempt should be made to conduct a double-blind study. This can most easily be done when the dietary change involves only a few nutrients and can be accomplished by introducing one or a few substitute foods for standard menu items. By alternating periods of the experimental and standard diets, it should be possible to blind both observers and subjects, since most institutional menus show some cyclic variation anyway. More sophisticated techniques, such as the use of naturally vs. artificially sweetened beverages as Rapoport[30] has used, are also possible.

Finally, proper statistical analysis is necessary. Ideally, a statistician experienced in the design and analysis of clinical trials should be involved in the study from the start. Such an individual can provide invaluable help in study design as well as statistical analysis, and can help the investigator avoid many of the design problems that have plagued past studies in this field.

Only through improvement in study design can research in the field of diet and criminal behavior advance. Without such improvement, future studies will simply repeat the mistakes of the past and will be equally inconclusive and difficult to interpret.

Summary

While the relationship between diet and crime remains an area for further research, most of the research that has been done has been plagued by serious deficiencies in design and analysis. As a result, there is currently little convincing evidence that dietary factors have any role in antisocial behavior. Although dietary intervention programs are being incorporated into correctional facilities, there is currently little convincing evidence of their effectiveness. Such programs are perceived by many researchers and health care professionals as an incorporation of food faddism into public policy. Furthermore, there is increasing concern about the negative social consequences of the unproven—but increasingly widespread—belief in a diet-crime connection. □

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REACTIVE HYPOGLYCEMIC TENDENCY AMONG HABITUALLY VIOLENT OFFENDERS

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Key Words: reactive hypoglycemia, insulin, habitual violence, impulsivity, antisocial personality, borderline personality, intermittent explosive disorder

It has been suggested that hypoglycemic tendencies may be connected with criminal and habitually violent and impulsive behavior.[1-6] Irritability, aggressiveness and abnormal behavior have been often reported in patients with labile diabetes.[7-10] Brown and his colleagues have reported that habitually violent military men have low concentrations of 5-hydroxyindoleacetic acid (5-HIAA) in cerebrospinal fluid.[11-13] This has also been reported among impulsive and habitually violent murderers and those who attempted murder,[14-16] both those with intermittent explosive disorder and those with violent antisocial personality[14] as classi-

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