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Dietary Factors and Hyperactivity: A Failure to Replicate

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ABSTRACT. Recent research suggests that sucrose consumption may be a factor in children's hyperactivity. Yet, the manner in which hyperactive behavior was assessed confounded hyperactivity and aggression, thereby reducing the conceptual validity of the findings. In addition, accepting a probability level of 0.06 as significant with 36 correlations, and using grams rather than portions as an index of food consumption might have contributed to a Type I error. When these three issues were addressed in the present study, no significant relationships emerged between sucrose consumption and hyperactivity or aggression assessed as separate dimensions. The age of the hyperactive children in this sample (M = 9.15 years) contrasted with that of the original research (M = 6 years 2 months) and this may contribute to the differential results. Suggestions for further research are outlined, and the need to (a) separate hyperactive children according to whether they receive stimulant medication or not, and (b) assess attention deficit disorders in addition to behavioral components of hyperactivity are stressed.

ALTHOUGH RESEARCH FINDINGS relating dietary factors to hyperactivity have not been convincing (Connors, 1973), the controversy generated by Feingold's (1975) food additive hypothesis continues unabated (Conners, 1973; Mattes & Gittleman, 1981; Rippere, 1983). Most recently, the influence of other foods on hyperactive behavior has been considered. One

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food substance that may be related to hyperactivity is sugar. Prinz, Roberts, and Hantmann (1980) studied sugar intake and behavior in 28 hyperactive and 26 normal children. Parents maintained a 7-day dietary record for each child, and food consumption (in grams) was correlated with observations of the children's behavior in a playroom during a 15-min period. Essentially, the amount of sugar products consumed was related to destructive-aggressive behavior and restlessness for hyperactive children, and with the number of quadrant changes for their normal counterparts.

However, a number of factors limit the generalizability of these findings. First, Prinz et al.'s assessment of behavior may not necessarily reflect hyperactivity. They take destruction-aggression as one index of hyperactivity. More recent research has separated hyperactivity and aggression (O'Leary & Steen, 1982). A related issue is the use of restlessness and locomotor activity (in the form of quadrant changes) as a measure of hyperactivity. It may be more appropriate to obtain an assessment of the social impact of these behaviors on significant others (e.g., teachers). Moreover, while the advantages of reliable and valid behavioral observations are obvious, questionnaires such as the Conners Teacher Rating Scale (TRS) (1973) or the Stony Brook Scale (O'Leary & Steen, 1982) may assess hyperactive behavior more precisely. In addition, such measures may be a more appropriate predictor. A second problem concerns the dietary assessment. Every substance consumed by the child over a 7-day period was recorded in grams. Since this measure is derived from an estimation of portions, correlation coefficients based on grams consumed may be inflated as this index reflects an increased range of scores. Finally, in assessing the relationship between foods consumed and behavior, 36 correlations were computed, yet a probability level of 0.06 was accepted as significant.

Taken together, these latter two problems increase the probability of Type I errors, whereas the assessment issue discussed first could reduce the conceptual validity of the findings. The present study replicates that of Prinz et al. and attempts to redress these issues. Thus, hyperactive behavior is assessed with a psychometrically valid scale that separates hyperactivity and aggression (Prinz et al., 1980). In addition, portions consumed are preferred to grams as a measure of food intake; and finally, a more stringent and appropriate probability level (alpha = 0.01) is used.

Method

Children

Hyperactive children (n = 13; M age = 9.15 years, SD = 1.99) were selected from a remedial school if they fulfilled one of two criteria: either they were diagnosed as hyperactive by a multidisciplinary team and were re-

ceiving stimulant medication, or had been diagnosed as hyperactive by this multidisciplinary team, were not receiving stimulant medication but scored greater than 1.5 on the 10-item TRS (Conners, 1980). The control children ($n = 14$; $M = 9.44$ years, $SD = 1.63$) did not differ from the hyperactive children in terms of age and were selected if their score on the 10-item TRS was equal to or less than 0.8. Hyperactive children differed from controls in terms of both hyperactivity (M: 21.77 vs. 6.44; t (26) = 6.79, $p < 0.001$) and aggression (M: 40.23 vs. 8.38; t (26) = 5.83, $p < 0.001$) on the SBS; they did not differ with regard to anxiety/depression ($p > 0.05$). The two groups of children also differed significantly as rated by their mothers on the Werry-Weiss-Peters Activity Scale (1968) (M: 39.99 vs. 20.56; t (26) = 3.12, $p < 0.01$).

Dietary Record

The method used for maintaining the dietary record replicated that of Prinz et al. entirely, with one exception. Rather than recording food consumption in grams, portions were used as the index. Rating of these portions was computed independently by two individuals, both of whom were unaware of the nature of the research or the conditions of the children. One of the raters was a qualified dietician, the other a final year graduate dietetic student. Each food category was classified into one of four categories, namely, sugar products, refined carbohydrates, nutritional foods, and unclassifiable food entries. Interrater reliabilities on these four categories were acceptable ($r = 0.91, 0.87, 0.51, 0.66$, respectively, all p's < 0.005). Had grams been used as an index rather than portions, these correlation coefficients would have been even higher because of the expanded range of scores. As in the Prinz et al. study, six scores were then derived: (a) total quantity of food intake; (b) sugar products; (c) sugar products and refined carbohydrates; (d) ratio of sugar products to nutritional foods; (e) ratio of sugar products and refined carbohydrates to nutritional foods; and (f) ratio of carbohydrates to protein. The percentage of food items not allowed on the Feingold diet was not used in this study: Research suggests that the Feingold diet is not related to hyperactive behavior (Conners, 1980) and recent research (Mattes & Gittleman, 1981) and Prinz et al.'s findings support this.

Procedure

Once the children had been targeted for inclusion in this research, their mothers were contacted and permission obtained for their children's participation. The mothers were then instructed individually on the method of maintaining the 7-day dietary record. During the course of the week, all

mothers were contacted once to ensure they experienced no difficulties, and the need for accuracy and detail was stressed. At the end of the week, the teachers of the 27 children completed both the 55-item Behavior Problem Checklist (Quay, 1977) and the 33-item TRS (Conners, 1973), both of which are required for generating the four factors of the SBS. They were instructed to rate the children's behavior not in terms of a global perspective, but rather as they perceived it during the period the dietary record was obtained. Throughout this one-week period, parents and teachers remained unaware of the nature of the research.

Prinz et al. had the parents complete the Cognitive Home Environment Scale (CHES) after the weeklong period. However, this scale was not administered in this research: Prinz et al. hypothesized that general parental competence as measured by the CHES might confound the results. Since they found no support for this, the CHES was omitted entirely.

Results

There were no differences between hyperactive and control children regarding the six dietary variables ($p < 0.05$).

To assess whether the hyperactive and normal children responded differently to the dietary variables, Pearson correlations were computed separately for the two groups between the six dietary variables and the four behavioral indices derived from the SBS, namely, hyperactivity, aggression, anxiety-depression, and uncoordination. Since 48 correlations were computed, the 1% probability level was accepted; and none of the correlations attained statistical significance (see Table 1).

Discussion

Unlike the Prinz et al. findings, hyperactive and normal children did not respond differentially to food intake. This pattern was consistent across diverse dietary factors and behaviors. A number of factors might account for the discrepancies between the findings of the two studies.

In the first instance, the manner in which hyperactive behavior was assessed differed somewhat. While the use of observations of destruction-aggression, restlessness, and quadrant changes may provide highly specific indices of children's antisocial behavior or general activity level, it can be questioned whether this truly reflects hyperactivity per se. This argument is all the more cogent since recent research suggests that aggression and hyperactivity are orthogonal dimensions, particularly in clinically referred children (O'Leary & Steen, 1982). Using the SBS in the present study resulted in these two behaviors being differentiated, and provided a more psychometrically acceptable index of hyperactivity. When such measures

TABLE 1
Correlations Between Dietary Factors and Hyperactivity Derived From the Stony Brook Scale[a]

Variable	Hyperactive group		Control group	
	Aggression	Hyperactivity	Aggression	Hyperactivity
Total quantity[b]	0.42	-0.21	0.10	0.29
Sugar products	-0.34	-0.35	0.16	0.36
Sugar products plus refined carbohydrates	0.45	-0.20	0.20	0.39
Ratio of sugar products to nutritional food	-0.23	-0.22	0.15	0.37
Ratio of sugar products plus refined carbohydrates to nutritional foods	0.29	0.12	0.17	0.39
Ratio of carbohydrates to protein	0.29	0.25	0.24	0.27

[a]Data on anxiety/depression and uncoordination factors are not presented since (a) there were no significant differences between the two groups, and (b) there are of no conceptual importance to this research. [b]$p > 0.01$ in all cases.

were used, no relationship emerged between dietary factors and hyperactive behavior. It is possible, therefore, that sugar consumption is associated with children's general activity level and bears no relationship to hyperactivity per se, which is a more specific constellation of behaviors.

A second factor contributing to the different results may be the index of grams used. Since this measure is derived directly from the number of portions consumed, it may serve to inflate the correlation coefficients by increasing the range of scores. A related statistical issue is that Prinz et al. accepted a probability level of 0.06, despite the large number of correlations (i.e., 36) computed. When a more appropriate significance level was accepted (alpha = 0.01), the results of the present study did not attain statistical significance. The possibility of a Type I error operating in Prinz et al.'s findings, therefore, cannot be discounted.

One aspect that may account for the fact that Prinz et al. showed a significant relationship between sucrose consumption and hyperactive behavior could be the age of the children. The mean age of Prinz et al.'s hyperactive children was 6 years 2 months; those in the present study were 9.15 years. Typically, relationships between behavior and dietary factors only emerge for younger children (Conners, 1980).

An alternative perspective could be that the magnitude of some of the correlations in this research and that of Prinz et al. were similar. For exam-

ple, the correlations between aggression and total quantity and sugar products plus refined carbohydrates for the hyperactive children in this study were 0.42 and 0.45, respectively. Yet, these correlations did not attain statistical significance, whereas Prinz et al.'s correlations of similar magnitude did. It remains for future research to assess whether such relationships are truly nonsignificant when the research methodology of this study is used, or whether utilizing a larger sample size together with the methodological refinements of the present research might result in significant associations.

Future research should also investigate whether such a relationship would emerge using younger children with the methodology of the present study. In addition, research should separate hyperactive children into those receiving and not receiving stimulant medication. This is an important consideration: One of the possible side effects of stimulant medication might be the suppression of children's appetite (O'Leary, 1980). Given that differential food intake is a major predictor variable in such research, experimental control of this potential confound is essential, particularly since Prinz et al.'s two groups differed in terms of the total quantity of food consumed. With regard to food intake itself, the focus of research has shifted somewhat from Feingold's suggestions of food additives to sugar consumption. Yet, other energy-producing foods (e.g., fats) occur regularly in children's diets, and their possible role should also be investigated. Finally, consistent with the viewpoint that an attention-deficit disorder is a major component of hyperactivity, it would be instructive to assess the influence of food consumption on this cognitive component as well as the behavioral aspects more frequently researched (Mattes & Gittleman, 1981). In any such research, direct experimental manipulation of dietary factors should be the method of choice. Until then, the food intake/hyperactive behavior hypothesis remains somewhat equivocal.

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