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ABSTRACT

This study used both between-subjects and within-subjects analyses to examine the effects of a gluten-free diet on the academic achievement of autistic children. The between-subjects analysis included data from eight autistic children (ages 5 to 7) with four on a gluten-free diet and four serving as controls. The number of attempts needed before mastering an assigned goal was used as the measure of achievement. No significant achievement difference was found between the two groups. The within-subjects analysis compared rates of achievement from 10 trials of 3 male participants before and 1 month after placement on a gluten-free diet. Analysis revealed a significant improvement in the rate of achievement following diet initiation. Possible reasons for these conflicting results are noted. (DB)

Effects of a Gluten-Free Diet on Rate of Achievement in Autistic Children in an Applied Behavioral Analysis Program

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Abstract

Many parents of autistic children have noticed that their children have reactions to certain foods, particularly those containing wheat and milk. The reactions include hyperactivity, rashes, and diarrhea (Shattock, 1991). Theoretically, these reactions occur because of an inability to break down certain proteins. Gluten, which is a protein principally found in wheat, contains certain sequences of amino acids that have the same opioid activity as endorphins. Since other research has implicated abnormal endorphin activity in autism, some postulate that gluten intolerance may contribute to its symptoms.

The present study used both a between subjects and within subjects analysis to examine the effects of a gluten-free diet on the academic achievement of autistic children. The between subjects analysis included data from 8 autistic children participating in an applied behavioral analysis program; 4 were on a gluten-free diet, and 4 served as controls. Control group subjects were matched for age and length of time in treatment. The number of attempts needed before mastering an assigned goal was used as the measure of achievement. For all subjects, the five most recently mastered targets were included. A one-way t-test showed no significant achievement difference between the two groups.

The within subjects analysis compared rates of achievement from 10 trials of 3 male participants before and 1 month after

placement on the gluten-free diet. The last five targets mastered before the diet was administered were included in the data set, as well as the first five targets mastered following one month on the gluten-free diet. A within-subjects t-test revealed a significant improvement in the rate of achievement following initiation of the diet ($p<.05$, $t=2.31$, $df=14$).

Introduction

Autism is a disorder marked by severe impairment in social, emotional, and intellectual functioning. Onset occurs in infancy, and the prognosis is generally poor (Lotter, 1978). The cause of childhood autism is still unknown. Professionals have tried a wide variety of interventions in an effort to help children with autism, but have met with limited long-term success (DeMyer, Hingtgen, & Jackson, 1981; McEachin, Smith, and Lovaas, 1993). Research has indicated that intensive behavioral intervention is associated with improved functioning on several follow-up measures (Lovaas, 1987; McEachin et al, 1993). Consequently, parents are increasingly using applied behavioral analysis in home-based training programs.

Despite the benefits offered by behavioral treatment, many parents remain desperate to find additional means of helping their autistic children. Some have turned to controversial methods such as facilitated communication, while others have tried unorthodox forms of biomedical intervention. Controlled

efficacy studies are sorely needed to assist parents in making informed choices about how to best address their children's special needs.

Research theorists have proposed that opioid peptides are involved in autism. Analysis of 24-hour urine samples from children with autistic disorders have shown increased levels of peptides (Reichelt et al., 1986). Researchers have indicated that gluten, a protein found in wheat, may play a role in this increased level of peptides. Gluten contains certain sequences of amino acids which have the same opioid activity as endorphins (Shattock & Lowdon, 1991). Some researchers maintain that autistic individuals may not have the capacity to metabolize these proteins completely. As a consequence, the remaining amino acid sequences may enter the blood stream through the intestine. Eventually, these amino acid sequences may make their way to the brain, cross the blood brain barrier, and produce drastic negative effects on neural transmission and development (Shattock & Lowdon, 1991). Since dietary gluten is believed to have serious deleterious effects for these susceptible individuals, use of restrictive diets has been proposed to reduce autistic children's exposure to gluten.

Knivsberg et al. (1995) have provided initial results on a study of a gluten-free diet as treatment for autism. Fifteen children were given behavioral, psycholinguistic, and cognitive tests before they started the diet and at a one year follow-up assessment. After a few weeks on the diet, parents and teachers

noted that some behavior worsened, but these symptoms disappeared after a few more weeks. After 1 year, psychotic behavior had decreased, as well as odd movements, fear, and resistance to physical contact. The use of language to communicate increased, and the range of emotions widened. Language was assessed by the Norwegian version of the Illinois Test of Psycholinguistic Abilities. All subscales, except for short term memory, showed a significant increase after 1 year on the diet. A measurement of cognitive ability showed that the children used their cognitive abilities in a different way when on the diet. It can be assumed that these functional changes are due to modifications in the pharmacological effects of the peptides produced by reduced exposure to gluten (Knivsberg et al., 1995).

Since a gluten-free diet has been shown to increase an autistic individual's psycholinguistic and cognitive abilities, it seems reasonable that a gluten-free diet would significantly increase the academic achievement of this same population. One of the most popular and effective educational approaches to autism is applied behavioral analysis. This treatment provides concrete criteria for measuring skill mastery. Behavior of children participating in this treatment is evaluated systematically, permitting detection of subtle changes in rate of achievement. Children receiving applied behavioral analysis were used as participants in the present study for this reason.

The current study provides both between-subjects and within-subjects analyses of the effects of a gluten-free diet on the

rate of achievement in autistic children participating in an applied behavioral analysis program. A significant increase in the rate of academic achievement was expected for those children placed on the gluten-free diet.

Method

Subjects

Eight autistic children, with ages ranging from 5 to 7 years, whose parents volunteered for participation in the study, served as subjects. All subjects were participating in a formal applied behavioral analysis program using identical criteria for skill mastery. Four of the subjects were on a gluten-free diet, and the remaining four served as controls. Placement into the gluten-free group was at parental discretion. Control group subjects were selected in order to match for age and length of time in the treatment.

Procedure

For the between-subjects analysis, each subject's five most recently mastered behavioral skills, called targets, were included. For each target, the number of attempts at mastery before the criterion was achieved was recorded. The total number of attempts for the five targets comprised the dependent measure for each participant.

The within-subjects analysis compared rates of achievement of five behavioral targets of 3 male participants, before and 1 month after the start of the gluten-free diet. The total number

of attempts for the last five targets mastered before the diet was administered comprised the pretreatment score for each participant. The total number of attempts for the first five targets mastered following 1 month on the gluten-free diet served as the posttreatment measure.

Results

A one-way t-test was used to compare the rate of mastery of the group of children placed on the gluten-free diet with that of the matched control group, in order to determine if a gluten-free diet significantly increased the rate of behavioral achievement. This between subjects analysis revealed no significant group difference in rate of achievement ($t=-1.10$, $df=20$).

Because substantial within group variability was noted, a within-subjects t-test was performed on the pretreatment and posttreatment measures of children on the gluten-free diet in order to provide a more sensitive measure of the effects of the diet on rate of achievement. This within-subjects analysis indicated a significant increase in rate of achievement following the implementation of the gluten-free diet ($t=2.306$, $p<.05$, $df=14$).

Discussion

Results of this preliminary study are inconsistent. While

the within-subjects analysis indicated that a gluten-free diet significantly improves the rate of achievement, the between-subjects assessment provided no such evidence of treatment efficacy. Substantial within-group variability may have made the between-group design insensitive to the subtle changes associated with the gluten-free diet. The within-subjects design permits each subject to in effect serve as their own control, which seems to have afforded a more sensitive assessment of change. However, the exceedingly small number of subjects in the within-subjects analysis compels caution in drawing conclusions from this analysis. Extensions of this study, using a larger sample of children on the gluten-free diet are clearly needed. In addition, this within-subjects design is marred by confounding of treatment effects by time effects. It is conceivable that the observed improvement in rate of achievement may have been due to the effects of time and experience, rather than a function of the gluten-free diet. There is a reasonable possibility that the rate of achievement would have increased over time regardless of diet. Future pre-post studies should include a matched control group, to determine if any observed increase in rate of achievement can be attributed to experience or time effects.

A further complication in this type of efficacy research involves confounds arising from the self-selection of families using a gluten-free diet. It seems plausible that parents who are willing to invest the considerable time and effort needed to sustain a gluten-free diet are devoting more energy to enhancing

their children[s functioning than other parents of autistic children. Often parents using the gluten-free diet are simultaneously experimenting with many other available treatments, which, in combination, may yield an improvement in rate of achievement. A double-blind design, with random assignment of children to the gluten-free diet and control groups would alleviate this problem.

The present study yielded conflicting results. Future research using a larger sample of youngsters placed on the gluten-restriction diet may help to clarify the efficacy of this intervention method. Until further results are obtained, it is not reasonable to state that a gluten-free diet significantly increases rate of achievement of autistic children participating in a behavior modification program. Because of the considerable difficulties associated with maintaining this diet, confounding factors should be eliminated from studies before their results are used as a basis for recommending that parents in general implement this diet with their autistic children.

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