

Evaluate the Effect of Reducing Sugars in Attention Deficit and Hyperactivity of Children

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Abstract

The present study aimed to evaluate the effect of reducing sugars in attention deficit and hyperactive of children. This was an experimental study with pretest - posttest and control group. The statistical population included children with attention deficit / hyperactivity disorder who visited Tehran Treatment Centers. In a semi-experimental study with control group, 30 children with Attention Deficit Hyperactivity Disorder (ADHD) were randomly assigned to an experimental group and a control group. Conner questionnaire was administered on the subjects. Attention Deficit and Hyperactivity was measured among the subjects in the first phase. An intervention was implemented on the experimental group while no intervention was administered to the control group. The first experimental group underwent refined sugar reduction program for 8 weeks. The collected data was analyzed using multivariate analysis of covariance. The covariance analysis results showed that Attention Deficit symptoms were reduced in sugar reduction experimental groups compared with the control group. According to findings, it can be concluded that sugar reduction is effective in decreasing the symptoms of attention deficit / hyperactivity disorder.

Keywords: attention deficit / hyperactivity disorder, artificial sweeteners and sugar substitutes, Conner Questionnaire

INTRODUCTION

Externalizing Disorders are among the most important disorders occurring in childhood. These disorders are resistant disorders of childhood and are known as the children's behavioral disorders. Externalizing disorders refer to law-breaking and aggressive behaviors referenced as three forms of Attention Deficit Hyperactivity Disorder, Conduct Disorder and Oppositional Defiant Disorder in DSM-IV-TR. These disorders majorly affect the children, families, teachers and society (Mash and Barkley, 2002).

Given that several dietary factors are recommended as causes of attention deficit / hyperactivity disorder, various regimes such as Feingold Diet (no sugar diet, eliminating allergenic foods and mega-vitamin therapy) is considerably recommended (Kraus, 2005).

Sugars-based diet strongly causes Hypoglycemia. Consequently, decentralization and high calories in this diet leads to hyperactivity (Kraus, 2005).

Methodology

This was a semi-experimental study with control group. We had two groups in this study: the

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group with reduced sugar diet and the control group with no intervention. According to DSMIV, the subjects should be selected from the children in school. The subjects were randomly divided into two groups. The questionnaires were administered to both groups in pre-test and post-test. The diet should be followed for 8 weeks. The children were visited once a week by a dietician during the period. All parents in both groups were trained in one day. The mothers were asked to follow the diet instructions given to them by the dietitian. The questionnaire was administered to both groups after the end of this period. The results were analyzed. After the end of 8 weeks, a break was given to the subjects. Then, the questionnaire was administered once again.

The statistical population and sample

The statistical population consisted of children with attention deficit / hyperactivity disorder who visited clinics or medical centers. The subjects were randomly selected. The sample for the pilot study was determined as 15 patients per group (Khalatbary, 2010). It should be noted that the subjects were matched in terms of attention deficit / hyperactivity disorder, gender and intelligence.

Data collection methods

In this study, the required data was collected through structured questionnaire of 48-item form of Conners Parent Rating Scale and Food Frequency Questionnaire.

Data collection tools

The 48-item form of Conners Parent Rating Scale (CPRS-48)

This questionnaire has been accepted as a screening tool and a measure of severity of symptoms in patients with ADHD (Conner *et al.*, 1998). The questionnaire was used in many global parts as the most common screening tool (Scheffer *et al.*, 2005). This tool was also used routinely in Iran (Najafi *et al.* 2004). The scale includes five main factor for conduct problems, attention and focusing problems (learning), psychosomatic, impulsivity and anxiety. In addition, another factor as hyperactivity index can be derived from the scale. The scale has appropriate reliability and validity. Conner (1973) reported reliability of the scale from 0.7 to 0.9 using test-retest method. The reliability of this scale was reported as 0.93 using Cronbach's alpha in Iran (Khoshabi and Pouretamad, 2002). Validity of the scale was reported from 0.76 to 0.90 (Shhayyan *et al.*, 2007).

Food Frequency Questionnaire

In this questionnaire, the frequency of food consumption is determined using the Control Lists. Sometimes, the data controls 24-hour dietary reminders. The lists designed for additional control encompass many foods. According to target control list, the list may contain a lot of food or only certain combinations of foods. For example, the list may include foods with high amounts of saturated fats. In this study, only the lists of refined sugars were used.

Epidemiological studies referred to food frequency questionnaire as the most appropriate method to assess the long-term diet plans. It is essential to measure validity and reliability of this tool to determine the right relationship between diet and disease. A study was conducted on receiving nutrients (lipid and glucose) to determine relative validity and reliability of the semi-quantitative food frequency questionnaire used in the study in Tehran.

The former study showed that food frequency questionnaire designed for Tehran Lipid and Glucose Study for most food groups had acceptable reliability and validity.

Implementation of the program

All the people assigned to this group were invited to the center and the steps to implement the program were explained to them.

The sugar program implementation method

Since the case is a legal document and a tool for the communication between the experimenter and the subject, a case was organized for each subject (Kraus, 2005). The nutritional care also aimed to reduce sugar consumption, which was monitored and assessed periodically to ensure the unsatisfactory objectives. The food frequency questionnaire is the most common tool used to obtain nutritional information. Prior to this intervention, the subjects were asked through interview or questionnaire to recall and report all food and drink consumed in the last 24 hours.

The food frequency questionnaire only consisting of the refined sugar was implemented by a dietician to measure baseline refined sugar intake to be compared with the amount of reduction in sugar intake (Kraus, 2005).

Assessment will be more accurate if the objectives were written in a measurable manner (Kraus, 2005). The parents were asked to monitor sugar consumption extracted from the list of food frequency questionnaire in order to reduce the sugar consumption and record the weight of all consumed sugars and act based on the instructions given by the nutritionist to observe the calories taken. The subjects were evaluated and controlled based on expert diagnosis by visiting the medical center office with approximately three weeks interval, so that accomplishing the goals will be facilitated. The Data on the amount of sugars, sucrose and fructose consumption was obtained before the intervention and during the study. Reduction in these nutrients was evaluated using all available data by the nutritionist with Nutritionist IV and SPSS. A significant decrease was observed in this study.

Data analysis methods and tools

The required data was collected through a questionnaire. The charts were drawn and the required statistics were calculated using descriptive and inferential statistical techniques with SPSS 21. Then, descriptive statistics including mean, standard deviation, frequency and percentage were used to describe the descriptive findings. In addition, one-way analysis of variance (ANOVA) was used to compare pre-test test results in Conner Questionnaire in both groups. In addition, analysis of covariance was used in each group to compare pre-test and post-test results. SPSS version 21 was used for data analysis.

The reliability coefficients of the questionnaire in the present study

Split Method

The questions were divided into two odd and even parts in order to assess the reliability of the questionnaire. Scores of the subjects were calculated in each part. The Correlation between the two parts was calculated using Spearman-Brown corrected correlation coefficient.

Internal consistency

Cronbach's alpha was used to assess the internal consistency of the questionnaire.

Table 1. Internal consistency of the questionnaire

| Scales | Hyperactivity | Attention Deficit |
|------------------|---------------|-------------------|
| Split | 0.75 | 0.74 |
| Cronbach's alpha | 0.79 | 0.77 |

Results

Descriptive findings relevant to pre-test, post-test and follow-up regarding the dependent variables for the experimental and control groups are shown in Table 4-1. It can be observed that the mean hyperactivity and attention deficit scores at pretest are lower than those obtained at post-test.

Table 2. Descriptive findings relevant to the research variables

| | Group | Hyperactivity | | Attention Deficit | |
|-------------------------------------|-----------|---------------|--------------------|-------------------|--------------------|
| | | Mean | Standard deviation | Mean | Standard deviation |
| Experiment (reducing sugars) | Pre-test | 16.1333 | 2.29492 | 12.9333 | 1.38701 |
| | Post-test | 14.9333 | 2.25093 | 11.8000 | 1.26491 |
| | FOLLOW-UP | 17.0000 | 1.81265 | 13.3333 | 2.09307 |
| Control | Pre-test | 17.4 | 4.70258 | 18.2667 | 6.63827 |
| | Post-test | 18.2 | 5.62139 | 18.2000 | 5.62139 |

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|-----------|---------|---------|---------|---------|
| Follow-up | 18.4000 | 5.56520 | 18.2667 | 5.62478 |
|-----------|---------|---------|---------|---------|

Performing multivariate analysis of covariance (MANCOVA)

Analysis results on attention deficit and hyperactivity in post-test in both control and the experimental groups by eliminating the effect of pre-test are shown in table below.

Table 3. MANCOVA results on scores of attention deficit and hyperactivity in the experimental group (eliminating refined sugar) and the control group by controlling the pretest

| | Value | F | Hypothesis df | Error df | Sig. |
|---------------------------|-------|-------|---------------|----------|-------|
| Pilai effect | 0.154 | 2.267 | 2 | 25 | 0.125 |
| Lambda-Wilks | 0.846 | 2.267 | 2 | 25 | 0.125 |
| Hetling effect | 0.181 | 2.267 | 2 | 25 | 0.125 |
| Maximum error root | 0.181 | 2.267 | 2 | 25 | 0.125 |

As observed in the table, level of significance of all tests indicated a significant difference between the experimental and control groups in at least one dependent variable. Two types of univariate analysis of covariance were performed to realize which difference is between which variables in the two groups in terms. The results are reported in the table below.

Table 4. Univariate analysis of covariance on hyperactivity and attention deficit in two groups (removing refined sugar) and control after adjusting pretest scores

| Group | Dependent variable | SS | DF | MS | F | Sig. | Effect rate |
|-------|--------------------|--------|----|--------|-------|-------|-------------|
| | Hyperactivity | 0.538 | 1 | 0.538 | 0.181 | 0.674 | 0.007 |
| | Attention deficit | 10.692 | 1 | 10.692 | 7.264 | 0.012 | 0.218 |

Based on results, there was a significant difference between hyperactivity scores in the experimental and control groups. In addition, there was a significant difference between attention deficit scores in experimental and control groups. According to the results, significant difference was observed between attention deficit adjusted scores in both groups at post-test by eliminating the effect of pre-test. Overall, based on these findings, it can be stated that eliminating refined sugars at posttest decreased attention deficit scores while no effect was observed on hyperactivity scores.

To clarify that whether the effect of intervention over time (from posttest to follow-up) are stable or not, a multivariate analysis of covariance with repeated measures was conducted on post-test and follow-up scores by controlling the pre-tests scores in terms of dependent variables. The following table summarizes the results of multivariate analysis of covariance with repeated measures on post-test and follow-up scores by controlling pretest in terms of dependent variables.

Table 5. Multivariate analysis of covariance with repeated measures on post-test

| | Value | F | Hypothesis df | Error df | Sig. |
|---------------------------|-------|-------|---------------|----------|-------|
| Pilai effect | 0.049 | 0.648 | 2 | 25 | 0.531 |
| Lambda-Wilks | 0.951 | 2.648 | 2 | 25 | 0.531 |
| Hetling effect | 0.052 | 2.648 | 2 | 25 | 0.531 |
| Maximum error root | 0.052 | 2.648 | 2 | 25 | 0.531 |

As seen in the table, all tests indicate that significant levels between the experimental and control groups at posttest and follow the scores. There is a significant difference between dependent variable.

Table 6. Analysis of covariance with repeated measures on and post-test and follow-up by controlling pre-test

| | Dependent variable | SS | df | MS | F | Sig. |
|----------------------------|--------------------|-------|----|-------|-------|-------|
| Within subject (time) | Attention deficit | 4.011 | 1 | 4.011 | 4.645 | 0.041 |
| | Hyperactivity | 0.179 | 1 | 0.179 | 0.234 | 0.633 |
| Time and group interaction | Hyperactivity | 7.306 | 1 | 7.306 | 8.461 | 0.007 |
| | Attention deficit | 1.646 | 1 | 1.646 | 2.146 | 0.155 |

According to results of analysis of covariance with repeated measures, the effect of time (from posttest to follow-up) on two dependent variables was significant, i.e. hyperactivity and attention deficit. In other words, time has affected attention deficit and hyperactivity scores at post-test. Given that mean hyperactivity and attention deficit scores have increased during follow-up, it can be stated that eliminating refined sugar did not stably reduce hyperactivity and attention deficit over time. This is because no significant difference was observed between follow-up and post-test after eliminating the effect of pretest. However, it can be concluded that sugar reduction has a short-term effect. Nevertheless, the symptoms of attention deficit and hyperactivity will return over time.

Discussion and Conclusion

In this study, 30 patients with attention deficit / hyperactivity disorder were randomly divided into two groups: 1- a group whose diet missed carbohydrate, 2- a control group. The mean and standard deviation of baseline consumption of simple carbohydrates was 142.23 ± 48.73 grams per day at the beginning of the study, which reduced to 7.94 ± 5.09 grams per day during the study. There was a significant difference between these two values. Fructose consumption at baseline levels was 7.9 ± 9.2 grams per day at beginning of the study, which reduced on average to 0.29 ± 0.22 grams per day. Mean sucrose consumption reduced from 38.6 ± 15.4 grams per day to 0.54 ± 0.34 grams per day.

Based on results, no significant difference was observed between hyperactivity mean scores in the experimental and control groups. In addition, a significant difference was observed between attention deficit mean scores in experimental and control groups. According to the results, a significant difference was observed between adjusted means of attention deficit in both groups at post-test by eliminating the effect of pre-test scores. In general, it can be stated that reducing refined carbohydrate at post-test decreased attention deficit scores while no effect was observed on hyperactivity scores. These results are consistent with those obtained by Azad Bakht *et al.* (2012), Amani (2005), and Hoover and Milich (1994).

Kim and HieJa Chung examined the relationship of attention-deficit and hyperactivity disorder with carbohydrate intake, diet quality, diet and behavior in school children. Eight boys and one girl (8.4% of the total) were at high risk of attention deficit disorder and hyperactivity among 107 students who participated in the former study. According to Kim and Chung, the children who received less carbohydrate from junk food were less at risk. However, no significant correlation was observed between total volume of simple carbohydrate taken from junk food and development of attention deficit and hyperactivity disorder. Azad Bakht *et al.* (2012) found out that children in the upper quintile score of sweeten dietary pattern are more at risk of attention deficit and hyperactivity disorder than those children in the lower quintile. In addition, a significant relationship was observed between adherence to the dietary pattern of fast food and the risk of attention deficit and hyperactivity disorder. In this study, a significant and independent relationship was found between sweeten and prepared dietary patterns and the prevalence of attention deficit and hyperactivity disorder. Amani *et al.* (2005) found out that carbohydrate consumption was an important factor in increasing the severity of the disorder among girls. They showed that a history of food allergy in children with severe degrees of

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hyperactivity / attention deficit disorder is two and a half times more than normal children. In another study, half of the mothers were told to give their children carbohydrate while the other half were told to give aspartame to their children. Those mothers giving their children carbohydrate stated that their children were more hyperactive than other children. These mothers criticized their children's behavior (Hoover and Milich, 1994). However, these results did not support those obtained in other studies. For example, in one study, researchers studied two groups of children among which one group received the foods containing carbohydrate while the other group received the food without carbohydrate. In this study, children who had received carbohydrate showed no difference in terms of learning and behavioral disorder compared to those that did not (Wolarich *et al.*, 1994).

Limitations

The present study had several limitations and weaknesses despite the significant results. The following limitations are mentioned.

- 1- This sample size was small; as a result, the results cannot be generalized.
- 2- The sample included the children living in Tehran. Then, the results cannot be generalized to the children with hyperactivity across Iran.
- 3- The subject matter was new. Then, lack of productive literature on the diet, especially eliminating synthetic materials, restrict generalization of the results

Recommendations

1. Since other therapeutic interventions such as psychotherapy and medication therapy were conducted on the children with attentions deficit and hyperactivity, it is recommended to compare the effectiveness of diets with other therapeutic approaches and consulting treatments.
2. It is recommended that further studies be conducted in other parts of the country.
3. It is recommended that research be done on a larger sample size.

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