

## Impact of Diet Intervention on the Attention Deficit Hyperactivity Disorder (ADHD) Symptomatology in School Going Children

G. K. Beela<sup>1\*</sup> and V.R. Raji<sup>2</sup>

<sup>1</sup>*Department of Community Science, Kerala Agricultural University, Vellayani, Thiruvananthapuram 695 522, Kerala, India*

<sup>2</sup>*Centre for Disability Studies, Poojapura, Thiruvananthapuram 695012, Kerala India*  
E-mail: <sup>1\*</sup><beela.gk@kau.in>, <sup>2</sup><rajirajesh2007206@gmail.com>

**KEYWORDS** Bakery Confectionery. Chocolates. Diagnostic and Statistical Manual of Mental Disorders. Food Elimination. *Maida* Products. Soft Drink

**ABSTRACT** Attention Deficit Hyperactivity Disorder is a neurobehavioral disorder which effects school going children. This study is a randomized controlled trial into the effect of diet intervention on the behavior of a random group of school going children who meet the diagnostic and statistical manual of mental disorders (DSM) IV criteria for Attention Deficit Hyperactivity Disorder (ADHD). The recent controlled studies on nutrition and Attention Deficit Hyperactivity Disorder (ADHD) recommends that diets to reduce symptoms associated with Attention Deficit Hyperactivity Disorder (ADHD) include sugar restricted, additive and preservative free, oligoantigene and elimination diet. In the present study, a questionnaire consisting of 25 questions in the form of five-scale rating was administered to the subjects in six sessions to determine the prevalence of Attention Deficit Hyperactivity Disorder (ADHD) symptoms during the diet intervention. Fifty children of the age group of 4-12 years with Attention Deficit Hyperactivity Disorder (ADHD) symptoms were selected. The experimental group consisted of 30 children and the control group consisted of 20 children. Experimental group underwent diet interventions and counseling in six sessions whereas the control group was not subjected to diet intervention. Statistical analysis was carried out using ANOVA and t-test. This study establishes that elimination of chocolates, *maida*, bakery confectionaries, soft drinks, and junk food in the diet and replacing them with highly nutritive value foods as per the Recommended Daily Allowance (RDA) can reduce the ADHD symptoms in school going children of age group 4-12.

### INTRODUCTION

Attention Deficit hyperactivity disorder is characterized by symptoms of inattention, hyperactivity, distractibility, over activity and impulsivity (Arnold et al. 2011). Many parents are concerned about the side effects of medication that is done for the treatment of ADHD. In spite of modern pharmacological advances, only thirty percent to seventy percent of children with ADHD respond to medications or stimulant drugs of interventions (Snider et al. 2003; Schnoll et al. 2003). Studies show that elimination of food colors in the diet can reduce the ADHD symptoms in children (Warring 2008). Certain studies indicate that modifying the diet can be an alternative to medication and also a better option

(Hill and Taylor 2001; Goldstein 2000; Epstein et al. 2007; Schmidt 1997). The accepted protocol for treatment of ADHD includes psycho-education, parent training, medication, behavioral therapies and diet intervention, but follow-up studies have reported limited long-term effects of multimodal treatment (Molina et al. 2009; Schmidt 1997). Research indicates that diet modification in children with ADHD can exhibit substantial changes in the symptoms of ADHD and behavior (Rucklidge et al. 2009; Jackie 2012; Stevenson 2010; Cruz and Bahana 2006; Jackie 2012). Feingold diet is a food elimination diet, which eliminates all artificial food colors, artificial food flavors and preservatives (Jensen et al. 2007) and studies have shown that when children were put on the Feingold diet, there was a dramatic reduction in the hyperactive symptoms. Warring et al. (2008), Kiddie et al. (2010), and Hill and Taylor (2001) have meanwhile developed a protocol for treating ADHD patients based on both medication and dietary intervention.

*\*Address for correspondence:*

Dr G.K. Beela  
Department of Community Science  
Kerala Agricultural University  
College of Agriculture,  
Vellayani 695 522, Kerala, India

To date hardly any research is done in India on ADHD in relation to diet intervention. The review of the literature of studies conducted outside India revealed both in support and against the possibility of foods or additives causing behavior disorders in ADHD children.

The present study is to determine the impact of food on the behavior of a heterogeneous random group of DSM IV diagnosed children with ADHD aged 4-12 years in randomized controlled trial.

### Hypothesis

The null hypothesis is that there is no effect of treatment (Diet Intervention with ADHD diet) on the behavior of scores of the subjects.

### Statement of the Problem

The problem of the current study has been stated as to study the impact of nutrition on the behavior of a heterogeneous, random group of children with ADHD in a controlled trial.

### Definition of Terms

1. **ADHD:** Attention Deficit Hyperactivity Disorder (ADHD) is a neurobehavioral disorder, which affects three to five percent of all school going children. The disorder generally manifests itself before the age of 7 and is characterized by symptoms of inattention, impulsive behavior and hyperactivity (American Psychiatric Association 1994).
2. **DSM- IV:** The Diagnostic and Statistical Manual of mental disorders (DSM) published by the American Psychiatric Association (APA), offers a common language and standard criteria for the classification of mental disorders (American Psychiatric Association 1994).
3. **ADHD DIET:** Based on the previous established studies (Cruz 2006; Duca 2010; Rucklidge et al. 2009) the ADHD diet in this study refers to a diet, which is with elimination of chocolates, confectionaries, *maida* products, junk foods and soft drinks whereas vegetables, fruits, rice, fish and meat are allowed every day as per the Recommended Daily Allowances stated by the ICMR. Occasionally the diet will be varied to avoid foods for which the child has a particular craving or dislike.
4. **Chocolates:** Chocolate in the current study refers to a brown colored food, which is sweet in taste and is prepared from the-orem cacao seeds, roasted and ground, which is a rich source of flavonoids and alkaloids such as phenethylamine, caffeine and theobromine.
5. **Maida Products:** Maida products in the present study are any food items made from the refined flour that has had the germ and bran removed with a whitening agent added, which contains a high proportion of starches, which are a subset of complex carbohydrate also known as polysaccharides. Maida products have lower protein content, which makes the flour softer.
6. **Bakery Confectionery:** The food items that are rich in sugar and carbohydrates are referred to as bakery confectionery. In this study, these include sweets, candies, nuts, chewing gum, pastries, cakes, chips, fried snacks and sweet breads.
7. **Soft Drink:** Soft drink in the current context refers to any drink that typically contains carbonated water, a sweetener, and a natural or artificial flavoring. The sweetener may be sugar, high-fructose corn syrup, fruit juice, sugar substitutes (in the case of diet drinks), or some combination of these. Soft drinks also contain caffeine, colorings, preservatives, and other ingredients. Fruit juice, tea and other such non-alcoholic beverages are technically soft drinks by this definition but are not considered as soft drink in this research study.
8. **Junk Food:** Junk food is the term used in this study for food containing high levels of calories from sugar or fat with little fibers, protein, vitamins or minerals and has little "nutritional value".

### METHODOLOGY

The methodology adopted to attain the objective of the present study is described below under various heads.

#### Ethics Approved

The Kerala state disability commissionerate approved the study protocol and thereby fund-

ed the project titled “Impact of Nutrition on Children with ADHD”.

### Sample

The sample of the current study consists of fifty children from the schools of Thiruvananthapuram district and the sequential clients at Centre for Disability Studies (CeDS) with ADHD symptoms. The sample screening was adapted based on DSM IV diagnostic criteria and interview with parents and teachers. Selection of the sample was based on inclusion and exclusion criteria.

### Inclusion Criteria

1. ADHD diagnosed according to DSM-IV-TR (American Psychiatric Association 1994). Diagnosis based on structured psychiatric interview and standard questionnaires to be completed by teachers/clinical psychologists.
2. Children aged between 4 and 12.
3. Children not taking medication such as methylphenidate.
4. Sufficient command of the Malayalam or English language.

### Exclusion Criteria

1. Family circumstances hampering completion of the elimination diet.
2. Children already on a diet or who have been on a diet in the past two months.
3. Children receiving behavioral therapy or medication at the time of registration.

### Registration

After the selection the samples were registered for the study. The sample selection and registration was done with the help of a clinical psychologist and developmental therapist. The procedure of the study includes the following steps:

1. Selection of sample on the basics of inclusion or exclusion criteria and psychometric tests
2. Registration
3. Educating the parents/teachers/students about the need of the study, the procedure and the expected outcome

4. Getting informed consent from the expected authorities and parents

Experimental group consists of 30 children and control group consists of 20 children. Experimental group underwent diet interventions and counseling in six sessions whereas the control group was not subjected to diet intervention.

### Assessment Tools and Methods

1. **Assessment of ADHD:** Assessment of ADHD was based on structured interviews using DSM IV criteria. The sample was assessed for ADHD by a clinical psychologist and developmental therapist, using the structured interview with DSM IV (Diagnostic and statistical manual of mental disorders), which is based on an ADHD checklist.
2. **Anthropometric Measurements:** Height and weight of children with ADHD were assessed using calibrated audiometers and electronic scales. The height and weight was then compared with the standard growth chart of ICMR.
3. **Dietary Recall/Nutritional Assessment Procedure:** The 24-hour diet recall/food recall was administered to the subjects by the dietician of CeDS to determine the dietary pattern of the subjects.
4. **ADHD Behavior/Symptoms Questionnaire:** A questionnaire consisting of 25 questions in the form of a five-scale rating was administered to the subjects in six sessions to determine the prevalence of ADHD symptoms by the developmental therapist.

Six sessions for Assessment of ADHD symptoms were as follows:

- VO=Initial Score
- V1=Chocolate Avoided Score
- V2=Maida Products Avoided Score
- V3=Bakery Confectionaries Avoided Score
- V4=Soft Drinks Avoided Score
- V5=Junk Food Avoided Score

### Data Analysis

The pre and post ADHD symptom scores of the subjects were subjected to statistical analysis using t-test and ANOVA.

## RESULTS AND DISCUSSION

The results of the present investigation are detailed as follows.

**Table 1: Sample details**

<i>Experimental group</i>		<i>Control group</i>	
<i>Male</i>	<i>Female</i>	<i>Male</i>	<i>Female</i>
25	5	16	4

The experimental group consists of 30 children (25 males and 5 female) and control group consists of 20 children (16 males and 4 female) (Table 1).

Table 2 clearly reveals that there is a remarkable and significant change in the ADHD scores of pre and post study in the experimental group who underwent diet intervention. This study establishes that elimination of chocolates, *maida*, bakery confectionaries, soft drinks, and junk food in the diet can reduce the ADHD symptoms in school going children of age group 4-12.

**Table 3: Total score of ADHD symptomatology after eliminating diet of the experimental group**

<i>Sessions</i>	<i>Total means of ADHD</i>
V0= intial value	99.4
V-1(chocolate avoided diet)	55.41
V-2(maida avoided diet)	23.65
V-3(bakery avoided diet)	13.88
V-4(soft drinks avoided)	8.723
V-5(fast food avoided)	4.45
F value =112.7	CD value =5.32

Table 3 depicts that the ADHD scores reduced after eliminating chocolates, *maida*, bakery confectionaries, soft drinks and junk food are found to be statistically significant (f value-112.71). The table clearly shows that the ADHD score has significantly reduced to 55.4 after eliminating chocolate. The score has reduced to 23.65 after eliminating chocolate and *maida* products. It is further reduced to 13.88 after avoiding

chocolate, *maida* and bakery products. The ADHD score has decreased to 8.723 after eliminating soft drinks along with chocolate, *maida*, and bakery. Finally, the score has become 4.4533 by avoiding junk foods along with other groups from a mean score of 99.4. Similar results were reported by Duca (2010) who explored the efficacy of elimination diet in the symptoms of ADHD in fifty children aged 4-12 years old and the study revealed that there was a significant decrease in symptoms of ADHD in children after elimination of diet. Yet another study of INCA by Pelssar (2009) revealed that the restricted elimination diet had a significant beneficial effect on ADHD symptoms. Warring (2008) in his cohort study results stated that the Western dietary pattern associated with an ADHD diagnosis contains higher intakes of total fat, saturated fat, refined sugars, and sodium and is deficient in omega -3 fatty acids, fibers and folate. The study also suggested healthy foods preferred are fish, steamed, grilled or canned vegetables, tomato, fresh fruit, whole grains, low-fat dairy products. The current study clearly authenticates that chocolate, *maida*, bakery confectionaries, soft drinks, junk food are associated with ADHD symptoms, which need to be replaced by healthy/nutritive value rich foods. Nutrition plays an important role in the ADHD symptomatology and several studies and research findings reveal that elimination of sugar enriched food (Ballard et al. 2010) like bakery and confectionaries, chocolates and *maida* (Sinn 2008) and inclusion of food items like vegetables and fruits in the diet, ADHD symptoms has been reduced such as attention improved and hyperactivity reduced (Cormier et al. 2007).

## CONCLUSION

This study establishes that elimination of chocolates, *maida*, bakery confectionaries, soft drinks and fast junk food in the diet can reduce the ADHD symptoms in school going children of age group 4-12. Diets that are associated with

**Table 2: Pre and post scores ADHD behaviour/symptom questionnaire of the controlled and experimental group**

<i>Group</i>	<i>N</i>	<i>Max score</i>	<i>Pre</i>	<i>Post</i>	<i>Difference</i>	<i>P value</i>	<i>T-statistics</i>
Control	20	125	117.9	99.1	18.8	<0.0001	-45.39
Experimental	30	125	117.6	29	88.5	<0.0001	-178.73

ADHD symptoms include high levels of calories from sugar with little fiber, vitamins and minerals, rich in sugar and carbohydrates, caffeine, colorings, preservatives, and other ingredients. Healthy diet, which includes high proteins, vitamins, and omega 3 supplements, has positive repute of efficiency. Hence it can be recommended that dietary intervention should be considered in children diagnosed with ADHD symptoms. Parents of children with ADHD should have a thorough understanding of the role of healthy diet and the elimination of diet. A dietician should be consulted before elimination of diet if children do not exhibit any change in the ADHD symptoms after subjecting to elimination of diet and consuming healthy/nutritive value foods, only then standard medical treatment and drugs can be considered.

The strength of this study was the multidisciplinary approach of dietary intervention, which included dietician, developmental therapist, clinical psychologist and pediatrician. The parents played a very important role in implementing the diet intervention to their children. A great attention was given in educating every individual parent through diet counseling, which spanned for six sessions. Six sessions for Assessment of ADHD symptoms were as follows:

- VO=Initial Score
- V1=Chocolate Avoided Score
- V2=Maida Products Avoided Score
- V3=Bakery Confectionaries Avoided Score
- V4=Soft Drinks Avoided Score
- V5=Junk Food Avoided Score

### RECOMMENDATIONS

The results of the study hence recommend that chocolates, *maida* products, bakery, soft drinks, and fast food should be eliminated in the diet of ADHD children. Also, substitute the diet with highly nutritive value food as per the Recommended Daily Allowances (RDA) recommended by Indian Council of Medical Research (ICMR).

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**Paper received for publication on March 2016**  
**Paper accepted for publication on December 2016**