

Elimination of sugar rich confectioneries in children with ADHD symptomatology

G.K. Beela and V.R. Raji

Learning disabilities such as Attention Deficit Hyperactivity Disorder (ADHD) which is also a neurobehavioral disorder are increasing and are currently drawing concern. This study is a randomised controlled trial into the effect of elimination of sugar rich confectioneries diet on the behaviour of a random group of school going children who meet the DSM IV criteria for ADHD. The recent controlled studies on nutrition and ADHD recommends that diets to reduce symptoms associated with 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 ADHD symptoms during the diet intervention with elimination of sugar rich confectioneries diet. Fifty children of the age group of 4-12 years with ADHD symptoms were selected. Experimental group consisted of 30 children and Control group consisted of 20 children. Experimental group underwent diet interventions and counselling in six sessions whereas the Control group were not subjected to diet intervention. Statistical analysis was carried out using ANOVA and T test to compare the pre and post intervention scores and the scores of the experimental and control group. This study establishes that elimination of sugar rich confectionaries like chocolates, bakery confectionaries and soft drinks in the diet and replacing with highly nutritive value foods as per the RDA can reduce the ADHD symptoms in school going children of age group 4-12.

Key Words : ADHD – Attention deficit hyperactivity disorder, Diet intervention, DSM IV criteria, Sugar enriched confectionaries, Diet elimination, ADHD symptoms

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INTRODUCTION

Attention Deficit Hyperactivity Disorder is characterised by symptoms of inattention, hyperactivity, distractibility, over activity and impulsivity (Arnold *et al.*, 2011) and is most commonly found in the school going children. Medication or stimulant drugs are the common and most studied treatment for children with ADHD.

Recent studies have shown that certain nutritional factors are linked with the ADHD symptoms and with diet modification such symptoms can be reduced (Duca, 2010 and Goldstein and Ingersll, 2000). Parents of ADHD Children desire an alternative to medicines / drugs and hence diet modification holds considerable appeal for them. Many Parents are concerned about the side effects of medication. Certain studies indicate that modifying the diet can be an alternative to medication and a better option (Hill and Taylor, 2001 and Jackie, 2012).

In spite of modern pharmacological advances only 30% - 70% of children with ADHD respond to medications or stimulant drugs of interventions (Rucklidge

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et al., 2009 and Castle *et al.*, 2007). Some children who take stimulant medication for the treatment of ADHD experience side effects including insomnia, reduced appetite, mood changes, weight loss, irritability, stomach aches and headaches (Snider *et al.*, 2003). Research indicates that diet modification in children with ADHD can exhibit substantial changes in the symptoms of ADHD and behaviour (Schnoll *et al.*, 2003; Pelsser *et al.*, 2009; Duca, 2010 and Stevenson, 2010). Hill and Taylor (2001) have meanwhile developed a protocol for treating ADHD patients based on both medication and dietary intervention. Feingold diet is a food elimination diet which eliminates all artificial food colours, artificial food flavours and preservatives and studies have shown that when children were put in Feingold diet, there is a dramatic reduction in the hyperactive symptoms (Goldstein and Ingersll, 2000; Cormier and Elder, 2007 and Schnoll *et al.*, 2003) but follow up studies have reported limited long term effects of multimodal treatment (APA, 1994; Molina *et al.*, 2009 and Warring and Lapene, 2008). 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 behaviour disorders in ADHD children.

Objective:

The present study is to determine the impact of the elimination of sugar rich confectioneries in the diet on the behaviour of a heterogeneous random group of DSM IV diagnosed children with ADHD aged 4-12 years in randomised controlled trial.

METHODOLOGY

Hypothesis:

The null hypothesis is that there is no effect of treatment (elimination of sugar rich confectioneries in the diet) on the ADHD symptom scores of the subjects.

Definition of terms :

ADHD:

Attention Deficit Hyperactivity Disorder (ADHD) is a neurobehavioral disorder which affects 3 to 5% of all school-going children. The disorder generally manifests itself before the age of 7 and is characterized by symptoms of inattention, impulsive behaviour and hyperactivity (Arnold *et al.*, 2011 and Goldstein and Ingersll, 2000).

DSM-IV :

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 (APA, 1994).

Elimination of sugar rich confectioneries:

In this study elimination of Sugar Rich Confectioneries refers to a diet which is with elimination of chocolates, confectionaries and soft drinks whereas vegetables, fruits, rice, fish and meat are allowed every day as per the Recommended Daily Allowances stated by the ICMR.

Chocolates:

Chocolate in the current study refers to a typically sweet, usually brown, food preparation of theorem cacao seeds, roasted and ground, often flavoured, as with vanilla. Cocoa solids are a source of flavonoids and alkaloids, such as therobromine, phenethylamine and caffeine.

Bakery sugar confectionery:

Bakery Sugar confectionery in this study includes sweets, candied nuts, chewing gum, sweetmeats, and other confections that are made primarily of sugar.

Soft drink:

Soft drink in the current refers to any drink that typically contains carbonated water, a sweetener, and a natural or artificial flavouring. 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, colourings preservatives, and other ingredients.

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 there by funded the project titled "Impact of Nutrition on Children with ADHD".

Randomisation and sampling :

The procedure of Sampling in this study includes the following steps; 1) Selection of sample on the basics

of inclusion / 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. 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:

(a) ADHD diagnosed according to DSM-IV-TR (1); Diagnosis based on structured psychiatric interview and standard questionnaires to be completed by teachers / clinical psychologists. (b) Children aged between 4 and 12 (c) Children not taking medication such as methylphenidate, (d) Sufficient command of the Malayalam or English language.

Exclusion criteria:

(a) Family circumstances hampering completion of the elimination diet, (b) Children already on a diet or who have been on diets in the past two months, (c) Children receiving behavioural therapy or medication at the time of registration.

Justification of inclusion and exclusion criteria :

A maximum age of twelve years old is only chosen in this study in order to increase the compliance with the diet. Children receiving medication or behavioural therapy at the time of registration were excluded, because this study is to investigate the influence of foods on ADHD without the behaviour also being affected by other therapies. Children already on a diet were being excluded for the same reason.

Immediately after the first measurement the children were randomly allocated to (A) Experiment group and (B) Control group. This moment of randomisation, i.e. after the first measurement, has been chosen to prevent any feelings of disappointment of the parents, which might arise when the child will be allocated to the control group, to impede the first measurement. Randomization was performed using randomised blocks, by means of ten boxes each containing 10 sealed envelopes (5A+5B). The sealed envelopes contain computer-generated cards with concealed assignment codes. This procedure was organised and administered

by an independent project fellow. The parents used to pick and open one of these envelopes in the presence of the researcher. Assignment was dispensed in accordance with the allocation in the envelope. Whenever the first box became empty, it was replaced by the next box. Blocks are deemed necessary to prevent an unequal distribution of treatments over time and to adjust for possible trends in scoring over time due to a learning effect of the observers or seasonal trends in efficacy of the treatment.

Assessments and single blinded measurements :

All children were assessed by an independent and blinded Child Development expert, Clinical Psychologist or Developmental Psychologist. The blinded measurements were conducted independently of the measurements of the researchers. The first examination consists of a general physical examination and a diagnostic assessment for ADHD.

Sample :

Sample of current study consists of fifty children from the schools of Thiruvananthapuram district. The sample of the current study selected randomly allocated to (A) a control group and (B) an experimental group. Experimental group consists of 30 children with ADHD (25 males and 5 females) and control group consists of 20 children with ADHD (16 males and 4 female). Experimental group underwent diet interventions and counselling in six sessions whereas the control group were not subjected to diet intervention.

Registration :

After the selection the samples were registered for the study. The sample selection and registration was done with the help of Clinical Psychologist and Developmental Therapist.

Assessment tools and methods :

Assessment of ADHD:

Assessment of ADHD was based on structured interview using DSM IV criteria. The sample were assessed for ADHD by a clinical psychologist and developmental therapist using the structured interview with DSM IV (Diagnostic and statistical manual of mental disorders) based ADHD checklist.

Dietary recall / Nutritional assessment procedure:

The 24 hr. diet recall/food recall was administered to the subjects by the dietician of Centre for Disability Studies (CeDS) to determine the diet pattern of the subjects.

ADHD behaviour / Symptoms questionnaire:

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 ADHD symptoms during the diet intervention by the Developmental Therapist.

Study design :

The diet used in this trial was very restrictive, it would be impossible to compose a reliable placebo diet without parents or teachers noticing this, thus impeding a placebo controlled trial. It is not possible for the researchers to be blinded as they have to advise the parents about the diet. Data entry was done by the Project fellows blinded to the assigned treatment. In addition, an independent and experienced Clinical Psychologist or Child Development expert who were blind to treatment conditions, executed assessment to investigate whether the children meet the DSM-IV criteria for ADHD. The Clinical Psychologist or Child Development expert was not been informed about the group the children have been assigned to. Children and parents were instructed not to reveal this information to the Clinical Psychologist or Child Development expert. The Clinical Psychologist or Child Development expert has to open a new file every time a child visits him, independently of the fact whether it is the first, second or third time the child is visiting them. The ADHD was administered to the parents after each phase.

The study was conducted in five phases. The main study lasts for 12 weeks and comprises of a baseline diet phase, elimination diet phase, and five measurement points. Following the first measurement in week 0, the children followed a 3-week baseline diet. After the second measurement in week 3 the children started with the elimination diet. At the end of week 6 and week 9 the third and fourth measurement was taken. At the end of the elimination diet, the fifth measurement was conducted after week 12.

The interviews in which the measurements are recorded was held with the parents in the absence of the

child. After each phase the child's behaviour was registered with the aid of questionnaires to be completed by the parents and the child's teacher, but not by the child itself. The interviews and questionnaires highlight the less agreeable aspects of the child's behaviour and could, therefore, be experienced as very negative by the child and, for that matter, by the parents as well. This is why this study has chosen not to conduct the interviews in the child's presence.

V0 phase (Week 0 – Entrance measurements: first interview, first blinded measurement) :

All 50 participants started the trial with an interview where the child's anthropometric measurement, medical and social history, the family situation, the mother's pregnancy and delivery of the baby, the child's school career, personal development and behaviour was discussed and recorded.

V1 Phase (Weeks 0 – 3, Baseline period: between first and second measurements) :

After the first measurement, all 50 children started with the baseline period, which is a 3-week period in which each child follows his or her own specific diet. No changes are made to the diet and no foods were avoided. The parents were asked to use this time to keep a detailed diary from which the child's normal eating habits may be inferred. In addition, the child's behaviour and any physical complaints and potential risks to compliance, such as before- and after-school care, staying at a friend's, or sports activities, are closely monitored and recorded. Both the Experimental group and the Control group kept a diary, which means that during this period both the two groups still run parallel to each other during the baseline diet. This measurement point was also the time when the children from the control group were placed on a waiting list; their eating pattern will not change. The children from the experiment group proceed to the elimination phase.

V2 Phase (Week 3 - 6, chocolate eliminated diet):

The second measurement point for all 50 children, that is, both the experiment group and the control group, took place after the baseline period. This measurement is particularly important to identify possible changes that may have occurred during the baseline period as a result, for instance, of the special attention given to the child.

Children assigned to the control group are placed on a waiting list while the intervention group follows the elimination diet. The waiting list group continues their normal eating pattern. No alternative form of treatment is offered to them, and parents are at liberty in this period to explore other research or treatment options.

V3 Phase (Week 6-9 bakery sugar confectionaries eliminated diet) :

In this phase the experimental group is eliminating the Bakery sugar confectionaries for 3 weeks. The third measurement point was after three weeks which was carried out only with the experimental group. The rating scale was administered by the blinded clinical psychologist to the parents in a structured interview form after this phase.

V4 Phase (Week 9-12 soft drinks eliminated diet):

During this phase the experimental group eliminates the soft drinks in their diet. The fourth measurement point was after three weeks which was carried out only with the experimental group. The rating scale was administered by the blinded clinical psychologist to the parents in a structured interview form.

Diet intervention :

The elimination diet is based on the few foods diet, but it is more extensive, allowing the children, on a limited scale, to use more foods than are permitted in the few foods diet. A diet chart was prepared to every child by the dietician as per the RDA recommended by ICMR. The diet basically consisted of rice, local vegetables, fruits, milk and fish which were allowed every day, in normal doses. Occasionally the diet will be varied to avoid foods for which the child has a particular craving

or dislike. The diet clearly prescribes for each day, which products and snacks the child must eat and drink. All ingredients are listed, and parents receive a grocery list, so that the risk of errors in the diet is reduced to a minimum.

Parents were given diet counselling programme by the dietician in which the importance of healthy food intake and the harm of the junk and sugar enriched foods were imparted. They were also given a diary all the phases, registering not only the behaviour of the child but also any dietary infractions. The diet varied for each individual child, depending on the need to make interim adjustments.

To motivate families who have been placed on the waiting list to complete the trial, all families in the control group were offered an opportunity to start the elimination diet after the final measurement in week 13 and to follow the same procedure as that followed by the experimental group.

V5 Phase (Week 13 – 14 , fifth measurement by blinded clinical psychologist or developmental therapist) :

The fifth measurement for both the intervention group and the control group was conducted at the end of the elimination diet (Experimental group) or halfway through the waitinglist period (Control group) at week 13. DSM IV criteria were administered on both the group by the blinded clinical psychologist or developmental therapist.

OBSERVATIONS AND ASSESSMENT

The result of the present investigation are detailed in Table 1 and 2.

Table 1 clearly reveals that there is a remarkable

Table 1 : Pre and post study scores ADHD behaviour/symptom questionnaire of the controlled and experimental group

Group	N	Max Score	Pre	Post	Difference	P Value	T-Statistics
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

Table 2: ANOVA table to determine the ADHD score after elimination of sugar rich confectioneries of the experimental group

Sessions	Total means of ADHD	Maximum score
V ₀ = Initial Baseline score	99.4	125
V ₁ = Chocolate eliminated score	55.41	125
V ₂ = Bakery confectionaries eliminated score	13.88	125
V ₃ = Soft drinks eliminated score	8.723	125
F Value =112.7	CD Value =5.32	

and significant change in the ADHD scores of pre and post study in the experimental group who underwent diet intervention. The ANOVA Table 2 depicts that the ADHD scores reduced after eliminating chocolates, bakery confectionaries and soft drinks 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. It is further reduced to 13.88 after avoiding chocolate, and bakery products. The ADHD Score has decreased to 8.723 after eliminating soft drinks along with chocolate, and bakery confectionaries.

Similar results were reported by Duca (2010) who explored the efficacy of elimination diet in the symptoms of ADHD in the study revealed that there was a significant decrease in symptoms of ADHD in children after elimination of sugar rich diet. Yet another study of INCA by Pelsser *et al.* (2009) revealed that the restricted elimination diet had a significant beneficial effect on ADHD symptoms. Warring and Lapene (2008) in his cohort study results states 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, fibres 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. Studies have shown that consumption of high amount of sugar has adverse effect on cognition and behaviour (Wolraich *et al.*, 1995).

This study establishes that elimination of chocolates, confectionaries and soft drinks, in the diet can reduce the ADHD symptoms in school going children of age group 4-12. Similar results have reported by several research studies (Joy, 2010; Schmidt *et al.*, 1997; Sinn, 2008; Newmark, 2009 and Transler *et al.*, 2010).

Summary and Conclusion :

This study establishes that elimination of chocolates, bakery confectionaries and soft drinks, in the diet can reduce the ADHD symptoms in school going children of age group 4-12. Diets that are associated with ADHD symptoms includes high levels of calories from sugar with little fibre, vitamins and minerals, rich in sugar and carbohydrates, caffeine, colourings, 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. Parent of children with ADHD should have thorough understanding of the role of healthy diet and the elimination of diet. Consultation of dietician should be taken 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 should be considered.

The strength of this study was the multidisciplinary approach of dietary intervention which included Dietician, Developmental Therapist, Clinical Psychologist and Paediatrician. The parents played a very important role in implementing the diet intervention to their children.

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