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RESEARCH ARTICLE

ASSESSMENT OF NUTRITIONAL STATUS AND BEHAVIORAL CHARACTERISTICS OF ADHD CHILDREN (4-10 YEARS) IN SPECIAL SCHOOLS OF PUDUCHERRY

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ABSTRACT

ADHD is one of the most common childhood brain disorders and can continue through adolescence and adulthood. The objective is to study the causes, nutritional status and behavioural characteristics of attention deficit hyperactivity disorder children aged 4-10 years in special need schools of Puducherry. The special need schools and the subjects was selected using purposive sampling technique to collect details on pre diagnosed attention deficit hyperactivity disorder children and other learning-disabled children, as the study was exclusive. The structured questionnaire was formulated to collect the details pertaining to the study. Further by using Statistical Package of Social Science, the mean results were calculated. The results of the study reveal that were majority of 63 percent of children with ADHD belong to first ordinal position, a higher value of 61.9 percent of male children were pre diagnosed with ADHD compare to female children of 58.3 percent. The major number of children was identified with combined type of ADHD. The maternal life style of ADHD children's mother was found to be 70.4 percent were leading sedentary life style. The consanguineous marriage was highly prevalent in parents of ADHD children. The energy and calcium intake is found to be deficit and fat content was excess in all three-age group. Eighty-three-point three percent of children's dietary pattern was non vegetarian. The intake of fruits and vegetables was identified with less frequency of consumption which mainly contains all nutrients for brain development. The processed and miscellaneous food consumption frequency was found to be higher 79.6 and 59.3 percent respectively. The awareness of sugar free, casein free, Feingold diet and gluten free diet along with food exchange list were provided for parents through awareness program. Which indicates to avoid artificial or processed foods and additives and besides gluten free diet also plays major role of ADHD children behaviour. Thus, the change in diet pattern can help children with ADHD. Future research in supplementation of foods can majorly help the community to manage ADHD children.

Keywords: ADHD, Nutritional status, behavioural, sugar free, gluten free, brain development, supplementation.

1. Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common childhood brain disorders and can continue through adolescence and adulthood (NIMH) U.S. (Stephen v farone *et al.,* 2003). Attention-deficit/hyperactivity disorder (ADHD) is affecting up to 1 in 20 children in the USA and many research states that prevalence of attention deficit hyperactivity disorder is higher in boys than girls. Australian guide line on ADHD states that children with attention deficit hyperactivity disorder are usually initiated with the symptoms from early child hood, they creates the problems when the child going to school and they become as the troublesome issue in their life span. They will find difficulty in paying attention, being focused, and controlling behaviour and over activeness will be more. These difficulties will further lead the children to lack in connected with educational, social and emotional function.

There are three subtypes of Attention deficit hyperactivity. They are predominantly inattentive type, predominantly hyperactive-impulsive type, Combined type (inattentive, hyperactive – impulsivity). All children will not have same type of

ADHD problem. It will differ from individual to individual. Some children may have inattentive behaviour alone or hyperactive behaviour alone but children also have combination of inattention, hyperactive and impulsivity together. Scientist has discovered a genetic basis for part of the dopamine problem that exists in some individual with ADHD. When the neurotransmitter like dopamine is not working properly will cause ADHD with all subtypes (Castellanos & swanson, 2002).

Attention deficit hyperactivity disorder can occur due to genetical reasons, prenatal exposure to nicotine and alcohol, prenatal exposure to maternal stress, exposure to toxins like lead, mercury and so on. Birth complications like premature birth, type of deliver, injury during pregnancy, acquired brain injury; thyroid function and improper diet can also lead to Attention deficit hyperactivity problem. (Konikowska K *et al.,* 2012).

Treatments can help to relive from ADHD symptoms but cannot cure completely. Researchers are making and finding more effective treatments and interventions, and using new tools as like brain imaging.

To analyse and gather information on nutritional status of ADHD, the health care people make use of questionnaire as an instrument and the assessment methods like anthropometry, clinical symptoms (based on their behaviour) and diet survey (3 day food recall and food frequency).

The aim is to study on causes, nutritional status and behavioural characteristics of attention deficit hyperactivity disorder children aged 4-10 years in special schools of Puducherry.

2. Materials and Methods:

Selection of Schools from urban area of Puducherry

Special need schools were selected for the study to collect details on pre diagnosed attention deficit hyperactivity disorder children and other learning-disabled children, as the study was exclusive. Special need schools are the place which improves (Bradley.K., *et al.,* 2009) their educational progress and helps to provide improvement out of their disabilities. The study was carried out by obtaining the prior permission from the higher authority of special need schools. The lists of schools are as follows below.

Table 1. List of special need schools selected for the study

S.No	Name of the schools	Area
1.	Bridges Learning Vidhyalaya	Reddiarpalayam
2.	Sathya Special school	Shivaji Nagar
3.	Mother special school for Mentally Retarded	Boomiapettai
4.	Certh India	Uppalam
5.	Carunnai society for education research and rehabilitation for mentally challenged	Reddiarpalayam
6.	Aseerva Special school	Reddiarpalayam

Phase II

Selection of subjects (4-10yrs) in special needs schools of puducherry

In order to find out the early causes and intervention, the children in the age group of 4-10 years were taken as subjects in this study. The subjects were selected based on the method of purposive sampling technique which refers a particular participant selected as subject for the study as they illustrate some specific characteristics which required for the study. With reference to the medical report from the special need school the children with ADHD and other learning disorder at age of 4-10 were selected. Table 2 represents number of children selected for the study.

Table 2. Number of children selected for the study

S.No	Name of the schools	Number of subjects
1.	Bridges Learning Vidhyalaya	14
2.	Sathya Special school	8
3.	Mother special school for Mentally Retarded	2
4.	Certh India	4
5.	Carunnai society for education research and rehabilitation for mentally challenged	6
6.	Aseerva Special school	20
	Total	54

Phase III

Formulation of questionnaire

A questionnaire is a dignified set of questions for obtaining information from respondents. The prime objective is to translate the researcher's information in form of specific questions that respondents can able to answer. It is the best tool and common method for data collection as it will be easy to collect information in large scale and to interpret it. A questionnaire is the main part of collecting quantitative primary data. The questionnaire enables quantitative data to be collected in a standardized way so that the data are internally consistent for analysis.

With this as a background the community-based survey was carried out to study the nutritional status and behavioral characteristics of attention deficit hyperactivity disorder children aged (4-10years) in special schools of Puducherry. A structured questionnaire was formulated and it was pre tested by the small crew of parents and with support of psychiatrics. They put forth their valuable suggestion regarding the questionnaire accordingly few changes were made and eventually the questionnaire was tested and it was finalized for further study.

3. Nutritional assessment of attention deficit hyperactivity disorder

3.1 Anthropometric measurements

Anthropometries which focus on obtaining physical measurement of an individual and matching them to standards that reflects on the growth and development of the individual. The height that is the length of child and weight that is mass of body where for height and weight it should be balanced so the BMI i.e. body mass index is calculated They were calculated by using formula:

Body Mass Index:

$$\frac{\text{Weight (kg)}}{\text{Height (m)}2}$$

Clinical Assessment

Any abnormality in hair, face, mouth, eyes, tongue, teeth, gums, skin, nails, lips, subcutaneous tissue, muscular and skeletal system were clinically assessed with help of physician.

Dietary assessment

A dietary history is the best means of getting dietary intake information, and refers to a review of an individual's usual patterns of food intake and the food selection variables that dictate the food intake. Food intake data was assessed by collecting using 3 day food recall method and the food frequency questionnaire.

Conduct of the study

Accordance with the prior permission the study was conducted in the respective institute. Among selected six special needs school 54 subjects were drawn. As the study was exclusive the children with ADHD and with other learning and behavioural problem were included. Based on purposive sampling technique by using medical reports of children as tool the subjects were selected for the study. The institute helped to assemble parents for collecting the data's pertaining to the children with attention deficit hyperactivity disorder and with other brain related problem. A pretested structured questionnaire was used as main instrument which was parent targeted questionnaire enclosed with following details like basic demographic details, mother health profile, father health profile, child's health profile with dietary pattern taken by Children and nutrients excess and deficit in them was calculated. The questionnaire was also enclosed with Diagnostic statistical manual for mental disorder edition IV check list to assess the children under which sub type of ADHD. The details in questionnaire were filled by interviewing parents individually. They responded patiently in the interview. All the collected data's were entered in excel sheet for statistical interpretation of data. Based on the response of parents to the study the awareness program was conducted on the topic of "FOOD and ADHD" which was taken place in the respective institutes where parents were assembled for the program.

4. Awareness program for parents of children with attention deficit hyperactivity disorder

After the collection of data, the awareness program was conducted in the schools to endow with knowledge on "FOOD and ADHD." Based on the research studies the details regarding what is ADHD and their types, causes, characteristics behaviour, modified food for ADHD children, food exchange for allergic foods and a sample of menu plan were provided and explained to them in the known language tamil. Power point presentation and videos were the mode of providing knowledge to parents. (Konikowska K *et al.,* 2012) states that the diet of pregnant and lactating woman and child may have significant role on the development and deepening of the hyperkinetic syndrome. There is much proof to show that it is connected to nutritional factors.

Chronic deficiencies of certain minerals such as zinc, iron, magnesium and iodine and insufficient dietary intake of long-chain polyunsaturated fatty

acids may have an important role on the development and deepening of the symptoms of ADHD in children. Polyunsaturated omega-3 fatty acids, mainly DHA, which are must for proper development and function of brain. Chronic deficiency of these minerals may lead to increased risk of ADHD in children. Thus, the importance of diet during pregnancy and infancy were explained to the parents with ADHD children. Many researchers were found a positive effect by eliminating food products containing synthetic food additives, like artificial food dyes and preservatives on the behavior of children with ADHD. This information was explained to the parents. Foods to be included and avoided and in which form they can be included for children was also explained in the awareness program. The significance of types of diet like casein free, sugar free, gluten free and Feingold diet for ADHD children was provided.

Further the importance of taking children to psychiatrist, psychologist or child paediatrician to manage children with ADHD were provided to the parents. As a take home message, the pamphlet was distributed to the parents which enclosed with explained details regarding ADHD, it types, causes, foods for them, food replacement or exchange list and a sample menu plan and how to manage children with proper positive behaviour were given in that which would be beneficial to them.

Data Analysis

The mean of results was calculated using SPSS software i.e. Statistical Package for Social Science. The mean value results were also interpreted with the graphical representation using bar diagrams and pie charts with detailed discussion.

Results and Discussion

From the selected 54 children the majority (51.9) percent were assessed with sub type of combined type, (37) percent children were comes under predominantly inattentive type and remaining (11.1) percent were predominantly hyperactive impulsive type. The development, clinical health and dietary aspects of the selected children were discussed.

5. Milestone development in children with ADHD at age of 24 months

Milestone development in children with ADHD at age of 24 months was shown in table 3.

Table 3 Milestone development in children with ADHD at age of 24 months

S.NO	Categories	Duration	Number %
1.	Social smile	Before 2 month	27(50)
		After 2 month	27(50)
2.	Head holding	Before 4 months	17(31.5)
		After 4 months	37(68.5)
3.	Sitting alone without support	Before 8 months	21(38.9)
		After 8 months	33(61.1)
4.	Standing without support	Before 1 year	17(31.5)
		After 1 year	37(68.5)
5.	Walking	Before 18 year	20(37)
		After 18 year	34(63)
6.	Speech	Before 2 years	12(22.2)
		After 2 years	42(77.8)

Number in parenthesis indicates percentage

The present study reveals that there is milestone developmental delay in children with attention deficit hyperactivity disorder in their 24 month of age. Among 54 children with ADHD equivalent of fifty percent of children were obtained with delayed social smile. A major of (77.8) percent children were identified to be with delayed speech in 24 month of milestone developmental stage. The head holding mile stone was delayed for (68.5) percent of children, (61.1) percent of children were undergone delay in sitting alone without support at 24 month of age, sixty eight point five percent of children were found to be with mile stone delay in standing without support and subsequently sixty three percent of children were assessed with delayed walking. This present study's result was

correspondence with Robert perna *et al.,* 2013 states that early delays in speech and motor milestones remains unclear in children with ADHD.

Morbidity pattern of children with ADHD

Thirty eight point nine percent of children with attention deficit hyperactivity disorder were affected with fever and cold frequently and (55.6) percent affected rarely. Meager five point six percent of children not affected to fever and cold.

Morbidity pattern of children with ADHD discussed in table 4

Table 4. Morbidity pattern of children with ADHD

S.NO	Morbidity pattern	Frequently	Rarely	Not at all
1.	Fever and cold	21(38.9)	30(55.6)	3(5.6)
2.	Intestinal infestation	0	21(38.9)	33(61.1)
3.	Abdominal pain	2(3.7)	30(55.6)	22(40.7)
4.	Common ear, nose and throat problems	1(1.9)	18(33.3)	35(64.8)
5.	Common eye problems	2(3.7)	8(14.8)	44(81.5)
6.	Common skin disorders	0	6(11.1)	48(88.9)
7.	Respiratory diseases	1(1.9)	3(5.6)	50(92.6)
8.	Heart diseases	0	1(1.9)	53(98.1)
9.	Genito urinary problems	6(11.1)	5(9.3)	43(79.6)
10.	CNS disorders	1(1.9)	6(11.1)	47(87)

Number in parenthesis indicates percentage

Subsequently eleven-point one percent of children were found with genitor urinary problems and the remaining children with other disorders like abdominal pain, ear, nose, throat problems, skin problem, respiratory problem, heart problem, central nervous system problem found to be very few. Therefore, the present study reveals that children with ADHD identified mostly with fever & cold eventually the prevalence rate of other disorder was very low.

Nutrient excess and deficit of children with ADHD

According to the study regarding role of nutrients in brain development (Michael georgieff K 2007) states that Nutrients and growth factors control brain development during fetal and early postnatal life. These include protein, energy, certain fats, iron, zinc, copper, iodine, selenium, vitamin A and so on. Based on this the current study focused on nutrients like carbohydrate, protein, fat, calcium, iron, magnesium, zinc and energy were assessed for the children with attention deficit hyperactivity disorder with a segmented age groups of 4-6, 7-9 and 10-12 years. Table 5 shows the nutrient excess and deficit of children with ADHD.

Table 5 Nutrient excess and deficit of children with ADHD

Nutrients	Age group 4-6	Excess deficit of age group 4-6	Age group 7-9	Excess deficit of age group 7-9
	Mean ± standard deviation		Mean ± standard deviation	
Energy (kcal)	1258.91± 1350.00	-91.09	1387.56±1690.00	-302.44
Protein (g)	31.56± 20.10	11.46	37.61±29.50	8.11
Fat (g)	44.50± 25.00	19.50	49.85±30.00	19.85
Carotene (ug)	849.11±3200.00	-2350.82	991.38±4800	-3808.62
Calcium (mg)	571.80±600	-28.20	621.05±600.00	21.05
Iron (mg)	13.78±13.00	0.78	15.84±16.00	-0.16
Magnesium (mg)	101.37±70.00	31.37	118.65±100.00	18.65
Zinc (mg)	5.27±7.00	-1.73	5.81±8.00	-2.19

Number in parenthesis indicates percentage

Nutrients	Age group 10-12 Mean ± standard deviation	Excess deficit of age group 10-12
Energy (kcal)	1936.74±2190.00	-253.26
Protein (g)	56.58±39.90	16.68
Fat (g)	66.46±35.00	31.46
Carotene (ug)	2326.44±4800	-2473.56
Calcium (mg)	752.31±800	-47.69
Iron (mg)	21.40±21.00	0.40
Magnesium (mg)	170.48±120.00	50.48
Zinc (mg)	8.01±9.00	-0.99

Age group of children with 4-6 years was assessed with the nutrients like carbohydrate, protein, fat, carotene, calcium, iron, magnesium, zinc and energy based on the three day food recall method and then nutrients amount were calculated. The mean protein content was 31.56(g) in children with ADHD when compared with the standard of 20.10 (g) it was 11.46(g) excess. The comparison of fat content's standard value 25 (g) with mean value 44.50 (g) shows that children were excess 19.50 (g) in fat consumption. Children majorly showing deficit in carotene, calcium, zinc and energy content as 2350.89 (ug), 28.20 (mg), 1.73(mg) and 91.09 (kcal) respectively. Eventually 0.78 (mg) iron and 31.37 (mg) magnesium were excess in children of 4-6 years with ADHD. Therefore from this study it was found that children with attention deficit hyperactivity disorder in the age group of 4-6 years were not meeting their daily requirements for the major nutrients like energy, calcium, carotene and zinc further the consumption of fat, protein and magnesium was higher than the recommended amount.

The nutrients for the children in the age group 7-9 years were assessed. The mean value of the nutrients was compared with the standard values in order to find out excess and deficit. Children with ADHD in this age group were showing deficit value in energy, carotene, iron and zinc as 302.44 (kcal), 3808.62 (ug), 0.16 (mg) and 2.19 (mg) out of 1690 (kcal), 4800 (ug), 16 (mg) and 8 (mg) respectively. Subsequently the major nutrients of protein were seems to be higher of 8.11 (g) in children with ADHD when compared with standard of 29.50(g), the fat intake was quite significant 19.85 (g) than compared to standard of 30 (g), the mean value of calcium is excess of 21.05 (mg) with standard of 600 (mg) and further magnesium was assessed with excess level in children with ADHD for 18.65 (mg) with standard of 100 (mg). Hence this currents study shows children with ADHD in the age group 7-9 were majorly deficit in energy intake and carotene and consumption of fat was significantly higher in children diet pattern.

The present study reflects that the children in the age group of 10-12 years were found to significantly deficit in energy mean value of 1936.74 (kcal) out of the standard 2190 (k cal) it was 253.26 (kcal) deficit, the calcium content of children was found to be deficit of 47.69 (mg) out of standard 800 (mg), 2473.56 (ug) of carotene seems to be deficit with the standard value of 4800 (ug) and meager deficit of 0.99 (mg) in zinc level out of standard 9 (mg). Further the content of fat was obtained to be higher 32.46 (g) in standard value of 35 (g), secondly 50.48 (mg) of magnesium is excess in children with attention deficit hyperactivity disorder, the protein content was found to be excess of 16.68 (g) in children and meager excess of 0.40 (g) of zinc in children with attention deficit hyperactivity disorder. Therefore, the current study reveals that children in the age group of 10-12 years were significantly deficit in energy intake, calcium intake level, meager deficit in milk whereas excess in amount of fat consumption.

Skipping of meals in children with ADHD

Skipping of meals in children with ADHD was shown in table 6.

Table 6. Skipping of meals in children with ADHD

S.NO	Categories	Number (%)
1.	Skipping milk	12(22.2)
2.	Skipping breakfast	4(7.4)
3.	Skipping lunch	1(1.9)
4.	Skipping dinner	3(5.6)
5.	Skipping milk & break fast	4(7.4)
6.	Not skipping any of the above	30(55.6)

Number in parenthesis indicates percentage

Children with attention deficit hyperactivity disorder were mostly twenty-two-point two percent were found to be skipping milk every day, secondly seven point four children were identified of skipping breakfast alone and skipping milk along with breakfast, besides five point six children were not taking dinner. Finally, fifty-five point six children were obtained without skipping any meals of the day. Therefore, in this study the prevalence of children with ADHD skipping meals was found to be significantly lower.

Awareness of parents on type diet for children with ADHD

Awareness of parents on types of diet for children with ADHD represented in table 7

Table 7. Awareness of parents on types diet for children with ADHD

S.no	Types of Diet	Number (%)
1.	Sugar free diet	11(20.4)
2.	Sugar & casein free diet	1(1.9)
3.	Sugar & gluten free diet	3(5.6)
4.	Casein & Gluten free diet	1(1.9)
5.	All four diet known	1(1.9)
6.	Gluten free	1(1.9)
7.	No awareness of any of above	36(66.7)

Number in parenthesis indicates percentage

Parents of children with attention deficit hyperactivity disorder of 54 were assessed for their awareness on types of diet that helps to manage ADHD children. From the study it was found that a majority of (66.7) percent of parents were not found to have the awareness about any of the diet. Whereas mainly twenty-point four percent were identified with awareness on sugar free diet, meager of one point nine percent parents was found with awareness on casein free diet, gluten & casein free diet, gluten free diet alone and all four diet of sugar free, casein free, gluten free, Feingold diet. Hence this study reveals that significant of parents of this population were not having awareness about diet for attention deficit hyperactivity disorder.

Food frequency of children with ADHD

Table 8 reveals the food frequency of children with ADHD.

Table 8. Food frequency of children with ADHD (Number%)

Food items	Daily (n	Weekly	Biweekly	Monthly	Rarely
Cereals like Rice, Wheat, Bread, Ragi, Corn	49(90.7)	4(7.4)	1(1.9)	0	0
Pulses like Red gram, Bengal gram	40(74.1)	11(20.4)	1(1.9)	0	2(3.7)

Vegetables Beans, Lady's finger, Drumstick	32(59.3)	12(22.2)	6(11.1)	2(3.7)	2(3.7)
Green leafy vegetables	3(5.6)	25(46.3)	9(16.7)	5(9.3)	12(22.2)
Roots and tubers like Onion, Potato, Carrot	39(72.2)	14(25.9)	1(1.9)	0	0
Fruits like Apple, Guava, Papaya	12(22.2)	18(33.3)	7(13)	5(9.3)	12(22.2)
Non vegetarian foods like Egg, Chicken, Fish	15(27.8)	30(55.6)	3(5.6)	0	4(7.4)
Milk & milk products like Buttermilk, Curd, Butter	44(81.5)	5(9.3)	0	1(1.9)	4(7.4)
Sugar &Jaggery	36(66.7)	6(11.1)	0	2(3.7)	10(18.5)
Oils like Palm oil, Ghee	39(72.2)	3(5.6)	1(1.9)	2(3.7)	9(16.7)
Nuts like Groundnuts, Almonds, Coconuts	35(64.8)	13(24.1)	3(5.6)	2(3.7)	1(1.9)

Number in parenthesis indicates percentage

The exploration of consumption pattern of diet in children with attention deficit hyperactivity disorder reveals that the cereals were majorly (90.7) percent consumed daily, secondly seven-point four percent of children were found to be taking cereals weekly and remaining one point nine of them consuming weekly twice. Mainly of fifty-nine-point three percent of children were obtained with consumption of pulses daily, twenty-two-point two percent were consuming pulses included food weekly, meager children were found to be taking pulses biweekly, monthly, and rarely of (11.1), (3.7) & (3.7) respectively. The majority of children were given with dosa, idly regularly and only in this form of cereal and pulses were combined and given to children where there are also other cereals, legumes and millets which have higher nutrient value for the brain development were not included in their diet. A major of (59.3) percent were found to be consuming vegetables every day where twenty-two-point two percent children consuming weekly. A few of (5.6) percent of children alone found to be taking green leafy vegetables daily and remaining (46.3) percent were given green leafy vegetables weekly, further (22.2), (16.7) and (9.3) were found to be given green leafy vegetables rarely, biweekly and monthly respectively.

From this the study identify that many important mineral consumptions through green leafy vegetables are not properly taken by children and only one type of green leafy like mulla keerai and agathi are included but many other green leafy like spinach, brahmi which containing high minerals required for brain development is missed out of consumption of children with ADHD. The children are not much interested in taking green leafy vegetables. A major of (72.2) percent of children with ADHD were assessed with the dietary pattern of consuming roots and tubers daily. Mostly potato, onion, carrot was taken significantly where raddish, yam, beetroot these were found to included very rare in their diet. Thirty three point three percent of children with ADHD were found with weekly consumption of fruits which are mainly coming under children's dislike section that mainly gives more vitamins, minerals, fibre and antioxidant content. The intake of non-vegetarian was more (55.6) percent children taking weekly and (27.8) percent of children are not eating without non vegetarian food.

As far as the consumption of non-vegetarian foods many of them are given in the form of fried cooking method like fish fry, chicken rice with chicken fry and even egg given in form of egg omelette but not in form of boiled egg. Thus, the nutrient content of these food gets destroyed in heat and frying. Milk which is one of the major sources of protein was identified to be consumed regularly by major of (81.5) percent of children but mostly they are consumed with the commercial products which due to the added preservative might cause hyperactive behaviour or they consumed in form of tea and coffee. The currents study recognized that among 54 children with ADHD a major part of (68.5) percent of them found with consumption of tea & coffee daily.

Subsequently the intake level of sugar was found to significantly higher in children with ADHD of (66.7) percent were consuming daily. This study states that prevalence in consumption of sugar was higher in children which mainly might cause increase in blood glucose level and leads to ADHD. A majority of seventy two point two percent children were found with oil in their diet pattern daily. Further sixty four point eight percent of them were recognized with consuming nuts daily.

Miscellaneous foods consumption of children with ADHD

Miscellaneous foods consumption of children with ADHD was shown in table 30

Table 9. Miscellaneous foods consumption of children with ADHD(Number%)

Miscellaneous foods	Daily	Weekly	Biweekly	Monthly	Rarely
Mixture, murukkuetc	32(59.3)	13(24.1)	0	2(3.7)	7(13)
Fried snacks (Bhajji, Samosa)	24(44.4)	20(37)	2(3.7)	3(5.6)	5(9.3)
Sweets	19(35.2)	14(25.9)	5(9.3)	2(3.7)	14(25.9)
Eating out	6(11.1)	9(16.7)	2(3.7)	11(20.4)	26(48.1)
Tea / coffee	37(68.5)	6(11.1)	1(1.9)	0	10(18.5)

Number in parenthesis indicates percentage

As far as the children with consumption of miscellaneous food were found to be significant, the snacks like mixture or murukku were taken mainly (59.3) percent of children daily and (24.1) percent children were taking weekly. The other junk foods like bhaji, samosa was consumed by children majorly (44.4) percent regularly and secondly thirty seven percent of them consumed weekly. Junk foods which mainly to be reduced in their diet was quiet in high frequency of consumption in the population of current study. Sweets which mainly contains high amount of sugar taken largely of (35.2) percent of children which plays a major in blood sugar level with prevalence of ADHD. Children in consumption of tea and coffee were seems to be greater of (68.5) percent every day. Eventually the frequency of eating outside in children with ADHD were (11.1) percent only taking each day and a major of fourty eight point one percent children were taking it rarely.

Processed food consumption of children with ADHD

Processed foods consumption of children with ADHD discussed in table 10.

Table 10. Processed foods consumption of children with ADHD(Number%)

Processed foods:	Daily	Weekly	Biweekly	Monthly	Rarely
Biscuits	43(79.6)	6(11.1)	1(1.9)	1(1.9)	3(5.6)
Processed chips snacks	37(68.5)	8(14.8)	2(3.7)	1(1.9)	6(11.1)
Soft drinks, flavoured	13(24.1)	8(14.8)	7(13)	2(3.7)	24(44.4)
Ice items	19(35.2)	10(18.5)	3(5.6)	4(7.4)	18(33.3)
Icecreams	12(22.2)	16(29.6)	4(7.4)	7(13)	15(27.8)
Candies, lollypops	33(61.1)	7(13)	1(1.9)	1(1.9)	12(22.2)
Chocolates	38(70.4)	8(14.8)	0	0	8(14.8)
Artificially coloured / flavored foods	21(38.9)	10(18.5)	6(11.1)	3(5.6)	14(25.9)

Number in parenthesis indicates percentage

Processed foods which mainly contains high amount of artificial colors and additives, the frequency of consuming biscuits in children with ADHD was greater (79.6) percent of them taking it every day in their diet pattern. As far as the processed chips and snacks concerned in children with ADHD significant percent of (68.5) of them consuming daily, secondly (14.8) percent of them taking it weekly, soft drink or flavoured which are available in different flavors, color and taste but it mainly contains high amount of sugar and food additives, gas which provides large amount of calories twenty four point four percent of children drinking soft drinks daily where fourty four point four percent children taking it rarely. Different flavored ice creams and ice items like strawberry, pista and more which enclosed with many colors that may play role of causes of ADHD in children were taken by a major of (22.2) and (35.2) percent of children respectively. But ice cream that mainly come in the liking food of children. Besides the main processed food which was mostly liked and taken by major of seventy point four percent of children every day and candies and lolly pops which taken mainly (61.1) percent of children each day. Finally the frequency of consumption of artificially coloured foods like cotton candy, kesari were studied from which it found that (38.9) percent of children with ADHD taking it regularly.

Behaviour of children with ADHD in hungry time

Table 11. Behaviour of children with ADHD in hungry time

S.No	Behaviours	Number (%)
1.	Having head aches	1 (1.9)
2.	Dizzy	1(1.9)
3.	Moody	2(3.7)
4.	Tired	9(16.7)
5.	Shaky	0
6.	Irritable	14(25.9)
7.	Hyperactive	5(9.3)
8.	Normal	14(25.9)
9.	Tired with irritable	3(5.6)
10.	Tired with hyperactive	1(1.9)
11.	Irritable with hyperactive	4(7.4)

Number in parenthesis indicates percentage

Irritable behaviour was majorly (25.9) percent found to be in children with ADHD, Sixteen point nine percent of children were with behaviour of getting tired in their hungry time, nine point three percent of children were found to be hyperactive, irritability along with the behaviour of hyperactive was assessed in seven point four percent of children with ADHD, five point six percent of children were experiencing tiredness with irritable behaviour during hungry, response behaviour of moodiness was seen in three point seven percent of children, no behaviour of shakiness was found in children, besides twenty five point nine percent of children with ADHD was identified with normal behaviour during hungry time.

Conclusion

From the current study the importance of nutrition is emphasized that children with age group of 4-12 were found to be deficit in major nutrients like energy, calcium, protein and significantly excess in fat content which means that the consumption level of fat rich foods in form of fried foods like bhaji, samosa and further many artificially colored foods and the sugar consumption of children with ADHD are which contribute aggressiveness. The combined type of ADHD in children was highly prevailed. The behavior of irritability also found in children. Hence the diet of sugar free, casein free in which casein protein cause hyperactivity, Feingold diet which indicates to avoid artificial or processed foods and additives and besides gluten free diet also plays major role of ADHD children behavior. Thus, the change in diet pattern can help children with ADHD. Future research in supplementation of foods can majorly help the community to manage ADHD children.

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2. Funding: This study was not funded by any organiser or agent.
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