GARDENING BASED DIET THERAPY FOR SCHOOL GOING STUDENTS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

by

MALAVIKA, G.
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THESIS

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DECLARATION

I, hereby declare that this thesis entitled **"Gardening Based Diet Therapy for School Going Students with Attention Deficit Hyperactivity Disorder"** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Vellayani
Date:२१/01/2020

MALAVIKA G
(2017-16-003)

CERTIFICATE

Certified that this thesis, entitled **"Gardening Based Diet Therapy for School Going Students with Attention Deficit Hyperactivity Disorder"** is a record of research work done independently by Ms. Malavika G (2017-16-003) under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

Vellayani
Date: 21/01/2020

Dr. Beela G. K.
Major Advisor, Advisory Committee
Associate Professor
Department of Community Science
College of Agriculture, Vellayani

CERTIFICATE

We, the undersigned members of the advisory committee of **Ms. Malavika G (2017-16-003)** a candidate for the degree of **Master of Science in Community Science (Food Science and Nutrition)** agree that this thesis entitled **"Gardening Based Diet Therapy for School Going Students with Attention Deficit Hyperactivity Disorder"** may be submitted by **Ms. Malavika G (2017-16-003)** in partial fulfillment of the requirement for the degree

Dr. Beela G. K
(Chairperson, Advisory Committee)
Associate Professor
Department of Community Science
College of Agriculture, Vellayani

Dr. Anitha Chandran
Assistant Professor
Department of Community Science
College of Agriculture, Vellayani

Dr. Seema B
Professor and Head
Department of Agrl. Extension
College of Arigulture, Vellayani

Dr. Brigit Joseph
Professor and Head
Department of Agrl. Statistics
College of Agriculture, Vellayani

Dr. Suma Divakar
Professor and Head
Department of Community Science
College of Agriculture, Vellayani

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LIST OF ABBREVIATIONS

ADHD	Attention Deficit Hyperactivity Disorder
ODD	Oppositional Defiant Disorder
CD	Conduct Disorder
AUD	Alcohol Use Disorder
AFC	Artificial Food Colour
FFD	Few-Foods Diet
PUFA	Poly-Unsaturated Fatty Acids
PDD	Pervasive Developmental Disorders
DSM	Diagnostic and Statistical Manual for Mental Disorder
NICE	National Institute for Health and Care Excellence
ADORE	A Dialogue on Race Ethnicity
HKD	Hyper Kinetic Disease
ICMR	Indian Council of Medical Research
RDA	Recommended Daily Allowances

INTRODUCTION

CHAPTER :1

INTRODUCTION

"Garden is for healthy body and mind. When the world wearies and society fails to satisfy, there is always the garden". —Minnie Aumonier

Attention Deficit Hyperactivity Disorder (ADHD) is a disorder most commonly found in the school going children. ADHD is a multifactorial and clinically heterogeneous disorder that is associated with tremendous financial burden, stress to families and adverse academic and vocational outcomes. Attention Deficit hyperactivity disorder (ADHD) is a severe mental illness, associated with major impairment and a high comorbidity (Morstedt *et al.*,2015).

In India the prevalence of ADHD among primary school children is 11.32. % higher prevalence is seen among males (6.7%) than females (3.3%) (Jyothsna and Anuja, 2013). Worldwide the prevalence, in China is 6.1% - 8.9%, Australia 7.5% - 8.8%, Brazil 5.8%, Holland 1.8% - 3.8%, Germany 4.2%, New Zealand 6.7%, and in Canada 1.1% - 8.9% (Faraone*et al.*,2003).

Attention Deficit hyperactivity disorder is characterized by symptoms of inattention, hyperactivity, distractibility, over activity and impulsivity (Shaw *et al.*, 2007). Medication/drugs is the common and most studied treatment for ADHD. Recent studies have shown that certain nutritional factors are linked with the ADHD symptoms and with diet modification such symptoms can be reduced (Schnoll*et al.*, 2003). Parents of Children with ADHD 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. Studies show that elimination of food colours in the diet can reduce the ADHD symptoms in children (Nigg and Holton., 2012). Certain studies indicate that modifying the diet can be alternative to medication and also a better option (Richardson and Montgomery, 2005). In spite of modern pharmacological advances only 30% -70% of children with ADHD respond to medications or stimulant drugs of interventions. Same 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 (Wan *et al.*, 2016).

Studies also have shown that food affects the brain and behavior (Sullivan *et al.*, 2010) and researchers have found that there is association between nutrition and ADHD symptom (Stevens *et al.,* 2011). The accepted protocol for the treatment of ADHD includes psychological education, parent training, medication, behavioral therapies and intervention.

Research indicates that diet modification in children with ADHD can exhibit substantial changes in the symptoms of ADHD and behavior. Elimination of different food items includes sugar, maida, chocolate, bakery items and fizzy drink (Pfiffner and Haack, 2014).

Food preference and dietary habits are established during childhood and therefore diet therapy and interventions need to be targeted at young children while they are forming their lifelong habits. Diet therapy is a broad term for the practical application of nutrition as a preventative or corrective treatment of disease. This usually involves the modification of an existing dietary lifestyle to promote optimum health. However, in some cases, an alt alternative dietary lifestyle plan may be developed for the purpose of eliminating certain foods in order to reclaim health.

Diet therapy can be imparted through Nutrition education. Nutrition education can be defined as any set of learning experiences designed to facilitate the voluntary adoption of eating and other nutrition-related behaviors conducive to health and wellbeing. Nutrition education is an evidence-based, cost effective way to improve health outcomes and foster healthy eating habits for a lifetime. Since most children are enrolled in school, the class room is a suitable place to teach nutrition education. There are many ways one can teach nutrition; however, this study is a combination of nutrition education using multimedia tools and gardening. The art of nutrition education is breaking down a large body of knowledge into small, individual components that are represented to a patient or client at a rate and level, at which they are able to absorb and use the information. Effective education is making nutrition information digestible and usable in an everyday setting.

Gardening has proven to be successful tool in teaching nutrition to children. Gardening and related activities could lead to better attitude about fruits and vegetables. Gardening based education is an amalgamation of experiential education ecological and environmental awareness and agriculture literacy. Garden based nutrition education encompasses programs, activities and projects in which the garden is the foundation for integrated learning, in and across disciplines, through active, engaging, real-world experience s that have personal meaning for children, youth, adults and communities in an informal outside learning setting. In the past decade there has been an emergence of school gardens designed to create opportunities for children to learn about fresh food and improve the health of children. Hence the present study is attempted with major objective to eliminate unhealthy food items from their diet and promote healthy eating and to investigate its possibility through gardening-based nutrition education.

REVIEW OF LITERATURE

CHAPTER: 2

REVIEW OF LITERATURE

2.1. Definition of ADHD

According to American Psychiatric Association (1994), Attention Deficit Hyperactivity Disorder (ADHD) is a psychiatric disorder which affects 3% to 5% of all school- going children. The disorder generally manifests itself before the age of seven and is characterized by symptoms of inattention, impulsive behavior and hyperactivity, Buitelaar and Kooji (2000) stated that, ADHD is generally diagnosed in combination with other psychiatric disorders such as Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD). Yet another definition for ADHD is that it is a multifactorial and clinically heterogeneous disorder that is associated with tremendous financial burden, stress to families and adverse academic and vocational outcomes (Biederman *et al., 2005*). According to Morstedt *et al* (2015), Attention-deficit/ hyperactivity disorder (ADHD) is a severe mental illness, associated with major impairment and high comorbidity rate. A growing body of behavioral and molecular genetics literature has indicated that the development of ADHD may be attributed to both genetic and environmental factors (Curatolo *et al.*, 2010).

2.2. Causes/ Etiology

Unfortunately, the casual pathways of ADHD are largely unknown; ADHD is a complex disorder and multiple factors may contribute to its etiology (Thapar and Cooper, 2013). Apart from the involvement of many genes with a small effect (Franke *et al.*, 2009), multiple pre, peri and postnatal environmental factors may be risk factors for ADHD (Nigg and Holton, 2010 and Millichap and Yee, 2008). To date, the synergistic action between genes and environment is generally acknowledged (Academy of Medical Sciences, 2007 and Thapar and Cooper, 2013) and in ADHD genes 'are thought to cause the disorder in the presence of unfavorable environmental conditions' (Franke *et al.*, 2009). One of these conditions, though controversial, is diet (Daley, 2006; Millichap and Yee, 2008 and Stevenson *et al.*,2014).

2.2.1. Genetic Factors

Genetic factors play a dominant role in ADHD, but there are also a number of yet- to -be- identified environmental factors that may contribute to the disorder's development. Knowledge of the mechanisms that trigger ADHD is still based largely on speculation, so that opportunities for prevention cannot as yet be fully explored. ADHD symptom scores are highly heritable, maternal contrast effects appear to vary for different measures. According Knopik *et al* (2006) maternal smoking during pregnancy probably contributes to the association between maternal Alcohol Use Disorder (AUD) and offspring Attention Deficit Hyperactivity Disorder (ADHD) risk. The evidences for a significant genetic correlation suggest: pleiotropic genetic effects, with some genes that influence risk of AUD also influencing vulnerability to ADHD.

2.2.2. Environmental Factors

In children who are (genetically) vulnerable to ADHD, for instance, external factors may well trigger symptoms of the disorder. A comparable triggering function has been observed in the development of asthma, which is also basically a genetic disease. Various external factors, including dust mites, pet animals, pollen or foods, have been shown to contribute to the development of asthma, and avoiding these triggers may reduce the intake of drugs to a minimum (Pelsser, 2003).

Banerjee (2007) in his review proved that many environmental risk factors and potential gene-environmental interactions also increase the risk of ADHD. Mothers of ADHD children whose were exposed to moderate and severe stress during pregnancy tend to develop more severe symptoms than children with ADHD whose mothers were not exposed to prenatal stress (Grizenko, 2007). Smoking in pregnancy maternal urinary infection, being induced and experiencing threatened preterm labour increase risk of ADHD.

2.2.3. Food Factors

One of the research areas meriting greater attention is the impact that food may have on behavior disorders (Pelsser, 2003). There is a growing awareness among healthcare providers that the composition and quality of the food play a role in determining not only physical wellbeing, but also the behavior. Nutritional management is one aspect that has been relatively neglected to date and also nutrition factors such as food additives, refined sugars, food sensitivities/ allergies and fatty

acid deficiencies have all been linked to ADHD (Schnoll*et al.*, 2003). Research into effect of food on ADHD started forty years ago when pediatric allergist Benjamin Feingold hypothesized that both artificial food additives and foods rich in salicylates might be important etiologic agents of the hyperkinetic syndrome (Feingold, 1975). The Feingold studies were followed by other elimination diet studies, investigating the effects of either artificial food colour (AFC) elimination or of a diet eliminating many food and additives, i.e. the Few Food Diet (FFD), and by supplementation studies investigating the effects of vitamins, minerals and poly- unsaturated fatty acids (PUFA) on ADHD (Arnold *et al.*, 2005).

2.3. ADHD Diagnostic criteria

ADHD is diagnosed by physician according to a set of diagnostic criteria defined in the Diagnostic and Statistical Manual of Mental Disorders (DSM), Fourth and Fifth edition.In the DSM IV, published, in 1994 and DSM V, published, in 2000, ADHD is included in the broad category of neurodevelopmental disorders. A diagnosis of ADHD must include the presence of criteria in the areas of either inattention or hyperactivity or a combination of all three, that are present in two or more settings for a period of more than 6 months, were present prior to the age of 7, interfere with functioning in academic, social or occupational domains and they must not be accounted for by (PDD), schizophrenia or other psychotic disorders and other mental illness. DSM V is more operationalized and gives criteria for each of the disorders, listing how many criteria have to be met to make a diagnosis of a particular disorder, and what excluding criteria. Due to the fact it is used all around the world and since it has become the most used psychiatric manual, it is sometimes said that DSM is a "psychiatric Bible" (Arbans, 2015).

2.4. Intervention methods to treat ADHD

The current multimodal standard of ADHD therapy consists of pharmacological treatment and or behavioural or psycho- social therapy (Bolea-Alamanac*et al.*, and Nice, 2009). Psychostimulants are the first-choice pharmacological treatment (Bolea- Alamanac*et al.*, 2014) and have shown beneficial short- term efficacy, i.e. acute core symptom reduction (Charach *et al.*, 2004 and Van de Loo- Neus, 2011) in approximately 65- 80 % of children (Childress and Sallee, 2014), a reduction of criminality rates (Lichtenstein *et al.*, 2006) and of societal costs

(Van der Kolk *et al.*, 2015). However, children taking psychostimulants may still meet the ADHD- criteria (Riddle *et al.*, 2013) and complete normalization of behavior is rare (Shaw *et al.*, 2012; Sonuga- Brake *et al.*, 2011 and Molina *et al.*, 2009).

2.4.1. Medication

There is no conclusive evidence, however, that any of these treatments improve the long-term prognosis. Although methylphenidate, the drug most commonly used in the treatment of ADHD, has statistically significant short- term clinical effect, there is a lack of long- term randomized trial evidences (Pelsser, 2003). Furthermore, medication non- adherence occurs frequently (Pelham *et al.*, 2013 and Alder and Nierenberg, 2010): 30- 50 % of the subjects stop taking medication within 12 months (Wehmeier*et al.*, 2010) and 66- 80% within 3 years (Charach*et al.*, 2004; Garbe*et al.*, 2012 and Hong *et al.*, 2014). Apart from common side effects like sleep and appetite problems (Sonuga- Brake *et al.*, 2011and Charach *et al.*, 2004), medication may also affect growth and long-term bone health (Howard *et al.*, 2015). Finally, drug treatment does not attenuate the increased risk for school dropout and unemployment (Sibley *et al.*, 2011). In sum, better treatments preferentially aimed at prevention of ADHD in young children (Riddle *et al.*, 2013) and at targeting the underlying causes are welcome (Sonuga- Brake *et al.*, 2011). Milton (2018) states that most current scientific research projects center on medication may be an advantage for many patients. Spencer (2013) in his review suggests that therapeutic oral doses of stimulants decreases alterations of brain structure and function in subjects with ADHD relative to unmedicated subjects and controls. These medications associated brain effects parallel, and may underlie, the well- established clinical benefits.

2.4.2. Behavioral Therapy

Behavior therapy is one of the intervention methods that has caught attention. At this point of time, medication and behavior therapy are the main forms of treatment for children with ADHD. Several scientific research projects center on medication (Gezondheidsraad, 2000). One of the studies give support for effectiveness of Reasoning and Rehabilitation ADHD symptoms and comorbid problems, an improving function associated with impairment (Wilens and Spencer, 2010). The implication is that the benefits of Reasoning and Rehabilitation ADHD are multifaceted and the combined psychopharmacological and Cognitive Behavior

Therapy based treatments may add to and improve pharmacological interventions. Another study proves that Cognitive Behavior Therapy for adults with ADHD with residual symptoms is a feasible, acceptable and potentially efficacious next- step treatment approach, worthy further testing (Knouse, 2005).

2.4.4. Diet as an intervention

One of the studies proves that stimulated speculation that foods have an impact on the brain and produce adverse behavioral effects. Studies on food dyes in the 1970s, showed no cause and effect relationship between these additives and behavior. Since 1985 dietary studies, excluding not only additives but many different foods, have been conducted. The main difference to the additive studies, in which the children adhered to their normal diet, was that the dietary trails involved a total of diet: the children were put on a few food diets for a number of weeks, a diet in which only a few different foods were allowed. The rationale for using a highly restrictive diet during few weeks was the assumption that a child might show adverse behavioral reactions to any foods. Although different diet studies used different diets, the general idea of these randomized control trails was that only few different foods were allowed, including rice, turkey, lettuce, pears and water. These trails, exclusively involving children who met the criteria for ADHD, showed that 24% (in the most extensive diet and an unselected population) to 82% (in the most restricted diet and a highly selected population) of the subjects showed significant behavioral improvements. Unlike the additives studies, all trials based on the few food diet showed improvement in behavior, resulting in the conclusion that there is convincing double- blinded controlled evidence foe the efficacy of an elimination diet in a subgroup of children with ADHD. Hill and Taylor (2001) have meanwhile developed a protocol for treating ADHD patients based on both medication and dietary intervention. A diet eliminating the foods involved could be considered as a treatment of ADHD, thus eliminating the incriminated risk factors and preventing the ADHD symptoms (Pelsser, 2005).

2.5. ADHD Elimination Diet

Following a few food diets is difficult and puts a considerable strain on the whole family. Carter (1993) indicates that a less restricted diet, may be possible to have similar level of success. An elimination diet has been developed which is based

on the few food diets but is more extensive, allowing the children on a limited scale, to use more foods that are permitted in the few food diet. As a consequence, this elimination diet is easier to keep up and is much less burdensome foe both parents and the children, which is an important issue for parents, children and the ethical board. The elimination diet consists of rice, a range of vegetables, milk and water. And this complemented with specific foods like potatoes, fruits, some sweets and wheat, allowed in limited doses twice a week. Vegetables, fruits, rice and meat are allowed every day, in normal doses. Occasionally the diet will be varied to avoid foods foe which the child has a particular craving or dislike (Carter, 1993).

In another study it was noticed that a substantial number of subjects also had physical complaints, such as abdominal pain, diarrhea, headaches or asthma (Pelsser, 2003). Participants in one of the Dutch Dietary Trails (2002), 20 in 31 participants had three or more physical complaints and these complaints had reduced by the diet (Pelsser *et al.*, 2002). An elimination diet may not only have a beneficial effect on the behavior of children with ADHD, but also on the comorbid physical complaints. Since children showing extensive physical symptoms tend to respond less favorably to drugs, a dietary intervention may be optional for these children (Barkley, 1995).

A diet excluding just one food, like sugar or chocolate or an additive free diet is of little benefit to ADHD. In a trail, it has shown that some degree of hyperactivity, when exposed to artificial food colors and benzoate preservatives, may be applied to all 3-year-old children, not exclusively to hyperactive or atopic subgroups. These findings suggest that benefit would accurate foe all preschool children, if these additives were removed from their diet (Bateman *et al.*, 2004).

Hill and Taylor in 2001 published a basic algorithm for treatment of ADHD, a protocol derived from standard recommendations and evidence, intended for outpatient medical clinic practice in secondary care. In the protocol the use of a few food diet is being advised in predetermined cases of children with ADHD. In general, the existence and the results of the diet studies are ignored, rarely elimination diet as a possible treatment for ADHD is mentioned. Mostly only additive studies or sugar studies are quoted to underline that the idea of foods causing ADHD is wrong (Nigg and Holton, 2015).

2.5.1. Practical aspects of dietary research

Dietary trails with ADHD children generally consist of two phases: an elimination phase and a reintroduction phase (Carter, 1993 and Borris, 1994). A phased approach is necessary because there is evidence that children who respond to food by showing ADHD- typical behavior are generally sensitive to more than one food (Carter, 1993). This multiple sensitivity may explain the overall negative conclusions of the additive studies, eliminating just one element from the child's diet.

The elimination phase, can be considered as a first phase, after which the diagnosis "ADHD being triggered by foods", can be accepted or rejected. During thus phase, it will be investigated whether the child's behavioural problems decreases when following a restricted diet during some weeks. All children who show a significant response to the elimination diet will proceed to the second phase, the reintroduction phase. During the phase it will be determined which food are provoking the child's behavior, by reintroducing one by one the foods which were eliminated during the first phase of the trail. This phase will last until the child has returned as much as possible to his or her normal eating pattern. The second phase is a diagnostic phase, establishing which specific foods are incriminated. Eventually this phase will lead to a therapy, which consists of an advice about which foods should be avoided. Despite what parents expect, children seldom show ADHD behavior after eating colorants or sugar alone (Conners *et al.*, 1976 and Wolraich *et al.*, 1995) although a recent trail has shown that there is a general adverse effect of artificial food colouring and benzoate preservatives on the behavior of all 3 year old children, not only in hyperactive or atopic subgroups (Bateman *et al.*, 2004). Parents generally experience the reintroduction phase as extremely heavy, especially because their children revert to their former ADHD- typical behavior when eating certain foods and there is no way to anticipate when this will happen, because each child responds differently to different foods (Carter, 1993). This is one of the conclusions to be drawn from the follow- up of a Dutch trail "A Randomized, Controlled Study into Effects of Food on the Young Children with ADHD" (Pelsser. 2003). Based on parents rating as well as teachers ratings, the preliminary results of the study are that, more than 70% of the children (N= 7) show significant improvements in behavior in response to the elimination diet, according to both the Abbreviated Conners Scale (Borris, 1994) and ADHD Rating Scale (Zhang *et al.*, 2005). The study also shows

that reintroduction phase is very strenuous, particularly when the behavior of a child is triggered by several foods. This burden on child and family was confirmed by Carter (1993). Added to this is the fact that the reintroduction phase is long, because the foods are reintroduced one at a time (Carter, 1993). It is very important, therefore, to find a method to lighten the reintroduction phase and thus alleviate the burden of the second phase of dietary research.

2.6. Methods of Diet intervention

For the reduction of ADHD symptoms in children elimination of diet is seem to be the most promising dietary intervention (Rytter, 2015). Feingold Diet is the best-known dietary interventions and this diet is a food elimination diet which eliminates all artificial food colours and preservatives. It has advocated that children sensitive to a variety of foods and food colouring, including preservatives, may develop symptoms of ADHD as a reaction of these additives. Advocates for diet modification have made some claims starting that additive free diets will improve most if not all children's learning and attention problems. These advocates describe elimination diet case studies in which children could be removed from their current medication if their diet was maintained. They also report improvements in school for these children and deterioration in learning and behavior when the diet is not followed (Popkin, 2012). When evaluating Feingold's claims, case studies were shown to have some positive effects regarding the diet. There were severe dietary restrictions but these studies suggest that there was a small subset of children who demonstrated a dramatic reduction in hyperactive symptoms when following the diet (Schnoll *et al.*, 2003). There are some evidences that eliminating certain foods or altering their diets is beneficial to some children with ADHD. If a child is suspected to be sensitive to some foods, those foods can be eliminated on a trial basis under the supervision of a doctor or dietician to see if ADHD have been reduced (Ly *et al.*, 2017). Duca (2010) explored the efficacy of an elimination diet with regard to a decrease in ADHD symptoms in a group of young children.

2.7. Garden based intervention

This section provides an overview of garden-based nutrition education programs and discusses the range of such interventions found in the literature. Most interventions have been implemented in school settings and have focused on

delivering nutrition education, promoting decreased sedentary behavior, modifying the types of food that is served in school, and physical activity programs (Sharma, 2006). The rationale for these interventions is that behavioral modifications and healthy living promotion are sustainable and can be carried into adult years. However, most interventions focus on short- term changes. Overall, the interventions reviewed showed modest behavioral changes and individuals need support to make behavioral changes in their diet and exercise, but there also needs to be changes in policy and their environments outside of school in order to increase community- wide support (Sharma, 2006).

Many local agencies and communities have looked for ways to allow low income residents to gain increased access to fresh and healthy foods and promote increased physical activity and nutritional knowledge among children (Castro *et al.*, 2013). One strategy implemented by local governments and communities is the use of community gardens or school gardens. A community garden is described as a piece of land for gardening, tended to by a group of community members, and seen as a resource that provides increased access to fresh fruits and vegetables while promoting increased physical activity (Castro *et al.*, 2013 and Mc Cormack, 2010).

Another strategy that has been gaining in popularity is the use of school gardens as nutrition education programs for children. These kinds of programs are seen as a promising strategy for increasing preferences and improving dietary intake of fruits and vegetables (Robinson- O'Brien *et al.*, 2009). Garden based nutrition education programs are implemented in a wide variety of ways such as school based, during normal school hours, after school hours, afterschool program but on school grounds and community based, in a community garden either on weekends or during school hours (Robinson- O'Brien *et al.*, 2009). The use of community gardens or school gardens has received a great deal of attention in recent years and they are increasingly being used as teaching tools to address childhood diseases and fruit and vegetable consumption and exposure among children. Exposing children to a variety of fruits and vegetables at a young age and engaging them in the process of growing their own food promotes habitual consumption throughout life (Namenek Brouwer and Benjamin Neelon, 2013). These programs are not new and provide a wide array of benefits not only to children, but to the whole community.

Farm- to school programs, or programs that focus on connecting students with agriculture through the use of local farmers and community gardens, have been identified as an intervention strategy for childhood diseases (Berezowitz and schoeller, 2015). Peer- reviewed research in this area is limited, but the limited data available show a positive influence on children's knowledge and awareness of healthy food, willingness to try new foods, consumption of fruits and vegetables at school an home, physical activity and behavioral change that includes reduced consumption of unhealthy foods and soda and reduced television time (Berezowitz and Schoeller, 2015). Not only farm- to-school programs provide a positive opportunity to improve health, they also provide platform for discussing health, nutrition and food security issues at the school and community level. These kinds of programs also impact the family in a positive way by improving the family's ability to influence family diets, increasing parental knowledge of healthy foods, and expanding local availability of healthy food (Berezowitz and Schoeller, 2015).

Table 1: Research on garden-based nutrition education programs

Author and Year	Target Audience	Intervention	Theoretical frame work	Results
Castro *et al.*, 2013	95 children aged 2- 5 years old	"Growing Healthy Kids" intervention that included a weekly gardening session, a 7- week cooking and nutrition workshop, and social events for parents and children	Not stated	• 17 % of obese or overweight children had improved BMI classification. • 100% of children with a BMI classification of normal had maintained the classification. • Parents reported an increase of 46% in the availability of fruits and vegetables.
(Caufan, Yeh and Sigal, 2015)	School- aged children from 167 ethnically diverse families, 60% that qualify for free or reduced lunches.	"Garden of Eatin" early childhood education program featuring on site food gardens, curriculum alignment, healthy eating policies for students and staffs, family and community components	Not stated	• Participants reported program encouraged them to adopt healthy eating practices. • Participants reported access to fruits and vegetables, supported their ability to eat more healthfully. Interviews suggest underreporting of structural challenges to healthy eating.

		that include weekly distribution of fresh produce from its own gardens and the local food bank.		• The societal tendency to individualize the causes may discourage participants to share barriers to healthy lifestyles.
(Ellsworth, Ernst and Snelling, 2015)	408 middle school students from low-income middle school	45-minute lessons focused on nutrition education and sustainable farming concepts. Farmers market was delivered to schools in a converted school bus, allowing for full market setup to provide local fruits and vegetables as teaching tools.	Not stated	• Average scores increased from 51% to 58%. • Nutrition knowledge increased from 58% to 74%. • Agriculture questions remained 43%.
(Evans *et al.*, 2012)	246 adolescents (59% Hispanic, 70% low	The six components of The Sprouting Healthy Kids	Social Cognitive	• Students who were exposed to two or more components scored significantly

	income)	Intervention:1) in class lessons 2) after school gardening program 3) farm to school 4) farmers visits to schools 5) taste testing 6) field trips to farms.	Theory	higher on fruit and vegetable intake, Self-efficacy, and knowledge, lower preference for unhealthy foods.
(Gatto, Ventura, Cook, Gyllenhammer and Davis, 2012)	364 third to fifth grade Latino children participating in afterschool programs in Los Angeles elementary schools.	12- week nutrition, cooking and gardening intervention utilizing an evidence base curriculum demonstrated to decrease obesity.	Not stated	• Participants had an increased preference for vegetables. • Increased preference for three target fruits and vegetables and improved perception of taste. • In overweight/ obese subgroup, participants had a 16% greater increase in their preference for vegetables.
(Graham, Beall, Laughlin and Zenberg- cherr,	4194 California school participants	A self- administered internet and mailed survey was sent to all California	Not stated	• 43% of principals responded • Most frequent reason for having a school garden was for enhancing

2005)		principals to determine the status of gardens in California schools.		academic instruction. • Gardens were used for nutrition, environmental studies and science. • Principals strongly agreed that having curriculum on nutrition and academic instruction for the garden would assist in using the gardens for academic instruction.
(Jaenke*et al.*, 2012)	127 students aged 11-12 in 5th and 6th grade from two elementary schools in Australia	Nutrition-education program "How do you grow?" included three one-hour lessons in regular class time and gardening program. "How does your garden grow?" included seven one-hour sessions. where students involved in planting and tending to the	Social Cognitive Theory	• No significant gender differences in fruit and vegetable consumption of willingness to taste. • There was a group effect for overall willingness to taste, overall taste rating and the taste rating of pea, broccoli, tomato and lettuce.

		school garden.		
(Klemmer*et al.*, 2005)	647 third through 5th grade students from seven elementary schools in Temple, Texas. Experimental and Control group.	Students in the experimental group received science curriculum involving garden activities in addition to traditional classroom methods. Control group received only traditional classroom method.	Not stated	• Experimental group scored significantly higher score on the science achievement test • No difference among genders • Garden curriculum was most effective for boys in 3rd and 5th grade and girls in 5th grade.
(Koch *et al.*, 2006)	56 children in second through 5th grade from four different Texas countries.	"Health and Nutrition from the Garden"- a program that teaches children how to eat healthy on a budget? Program was offered in a full week format, once per 12 weeks or every morning for 1 week.	Not stated	• Improvement in the knowledge about health benefits of eating fruit and vegetables. • No differences were found in attitudes toward fruit and vegetables. • After participating in the program, participants reported eating healthier snacks.

(Lautenschlager and Smith, 2007)	40 boys and girls aged 9- 15 years	10-week gardening project that involved youth in gardening harvesting, cooking and eating.	Theory of Planned Behavior	• Willingness to eat nutritious food and try ethnic and unfamiliar foods. • Garden participants had a stronger appreciation for other individuals and cultures. • Participants more likely to cook and garden on their own.
(McAleese and Rankin, 2007)	99 6th grade students at three different elementary schools.	"Nutrition in the Garden" a 12- week nutrition education program	Not stated	• Increased servings of fruits and vegetables in garden-based group. • Increase pf 1.13 fruit servings and 1.44 vegetable servings. • Increase intake in Vit A, Vit C and fiber.
(Morris *et al.*, 2002)	200 4th grade students at three different schools	"Nutrition to Grow on" a program designed to teach children healthy eating habits while simultaneously	Social Cognitive Theory	• Significant improvements in nutrition knowledge and vegetable preference.

		teaching them where their food comes from by using a garden over the course of 9 lessons.		
(Moss *et al.*, 2013)	65 3rd grade boys and girls	Two nutrition education classes and a farm tour	Not stated	• Significant differences found concerning knowledge of fiber. • Knowledge of vitamins and reported vegetable consumption behavior at school and farm exposure were also significant.
(Namenek Brouwer and Benjamin Neelon, 2013)	Preschoolers from 4 childcare centers in North California	Two intervention centers and two control centers. Intervention included fruit and vegetable garden, monthly curriculum, and gardening support.	Not stated	• Post intervention, intervention and control centers served fewer vegetables in intervention. • Intervention children consumed more than control children.
(O'Brien and	38 4th grade students (17	An eight-lesson gardening	Social	

Shoemaker, 2006)	in intervention group, 21 in control group)	and nutrition curriculum with a hand- on gardening emphasis.	Cognitive Theory	• No differences in nutritional knowledge between or within groups at baseline and end of program. • Both groups at baseline and end of program • Experimental group maintained high self- efficacy and outcome expectations. • Control group scores increased significantly for gardening self-efficacy and outcome expectations.
(Ozer, 2007)		Review on literature on the impact school gardens have on students and schools	Ecological theory	• School gardens have the potential to promote health and well-being of students and can strengthen the environment with the school. • There is currently no systematic study on the impact of school

				gardens.
(Smith and Motsenbocker, 2005)	119 students in 5th grade at 3 different schools	Intervention: 14- week gardening curriculum from Junior Master Gardener. Students received 2 hours 1 time per week. Control group received no gardening curriculum.	Not stated	• Science achievement was significantly different for experimental classes' pretest and post test scores. • No significant difference for control. • Results show once weekly use of gardening activities and hand- on activities help improve science achievement test scores.
(Wansink*et al.*, 2015)	370 high school students in upstate New York who purchase lunch at the school cafeteria	Using greens harvested from the school garden in the school salad bar at lunch time	Not stated	• When the salad bar contained garden produce, the percentage of students selecting salad rose from 2% to 10% and on average students

				ate 2/3 of the servings they took. • Although waste increased relative to the control, more students were consuming at least some salad when it was from the school garden.

Table no 1 summaries research on many different kinds of garden- based nutrition education programs and their successes. These include programs implemented during school hours, after school, farm- to- school programs, programs with a cooking component, and programs aimed at children but implemented in a community garden. One item each of these programs has in common is that they all include an agricultural component that involves children participating in hand- on activities with fruits and vegetables. In program where the schools grow edible produce, students learn science and nutrition and harvest the vegetables. In some of the garden- based programs students not only harvest, but also learn how to cook and use these vegetables in their meals. In "farm- to- school" programs, schools purchase produce from local farmer's or markets and they come to the school with the produce. Then, the children visit the farm to understand how the food is grown and where it comes from. Most recently there has been a growing movement using these programs to promote the consumption of healthy food among a population of children with elevated rates of obesity (Popkin, 2012).

2.7.1. Benefits of garden- based nutrition education programs

Table no 1 clearly defines some of the benefits of garden- based nutrition education. It is evident that these programs have the ability to influence perceptions about fruits and vegetables, improve access to fruits and vegetables, increase nutritional knowledge and scientific knowledge, and increase self- efficacy levels. There are multiple pathways by which garden- based nutrition education programs can potentially strengthen the healthy development of children while also strengthening the school and surrounding community (Popkin, 2012).

A key area of focus for garden- based nutrition education programs has been to influence the consumption of fruits and vegetables. This has been an area of significant focus since childhood obesity is characterized by low fruit and vegetable consumption and school children consume only less than 5 fruits and vegetables on a daily basis (Laird, 2016). Evans *et al.*, 2012 in a research shows that only 6.2% of adolescents consume the daily-recommended amount of fruit and 5.8% consumed the daily- recommended amount of vegetables. Research reviewed 12 different peer- reviewed studies showed improvement in predictors foe fruit and vegetable consumption. In a community-based initiative conducted by Castro *et al.* (2013), the intervention was open to all families in the community with children less than 6 years of age. This piolet study was implemented in a low- income community and

was aimed at using community gardens as a vehicle to provide low- income families with children access to healthy food and information about healthy eating (Castro *et al.*, 2013). There was an increase in overall consumption of fruits and vegetable through this program, about 33% increase in vegetable and 28% increase in fruit consumption.

In a study conducted by Evans *et al.* (2012), "Sprouting Healthy Kids" multiple-component intervention showed that participants who were exposed to more than 2 components of the intervention had significantly higher fruit and vegetable intake than those who were exposed to fewer components. In another study, 99 sixth grade students at three different elementary schools were placed in a control group. One treatment group received a 12-week nutrition education program and other received the same program, but with garden-based activities. Their findings showed that participants who received garden intervention increased 1.13 servings of fruits and 1.44 servings of vegetables and additional significant increase in vitamin A, vitamin C and fiber (McAleese and Rankin, 2007). Ratcliffe *et al.* (2011) found that their garden-based nutrition education program, which was implemented one hour a week for 13 weeks at school, significantly increased the average number of vegetables participants consumed per month for participants in a garden intervention group versus control and also they found that gardening increased the variety of vegetables consumed.

Many programs measured changes in children's preferences towards fruits and vegetables. In a 12- week nutrition, cooking and gardening intervention aimed at 364 third through fifth grade Latino children called "LA sprouts", Gatto *et al.* (2012) found that participants in their program had an increase preference for vegetables, increased preference for three target fruits and vegetables and improved perception to taste and also participants who were obese or overweight had a 16% increase in vegetable preference, compared with control group. Overall, this intervention shows promise to change attitudes and perceptions about gardening, cooking, preparing fruits and vegetables, and the advantages of eating home- grown vegetables (Laird, 2016). In another study, it was found that in their intervention "Nutrition to Grow On," which was aimed at 200 fourth grade students at three different schools, participants in their program had significant improvements in nutrition knowledge and vegetable preference. In this study students in the nutrition and gardening group showed 33% improvement in their knowledge of the topics reviewed in that lesson (Morris *et al.*, 2002). In the intervention conducted by Ratcliffe *et al.* (2011), another positive

outcome they found in addition to increased vegetable discussion was, an increase in preference for vegetables among students in intervention group.

In one of the studies conducted among 103 preschoolers that after going through their PLANT Gardens (Preschoolers Learn About Nutrition Through Gardena) intervention by sharma*et al.* (2015) found that there was a significant increase in preschooler's willingness to try new fruits and vegetables. Lastly, Wansink*et al.* (2015) found that school students had a stronger preference for vegetables grown in a garden, than from the store. When the salad bar at school contained garden produce, the percentage of students eating salad rose from 2% to 10%, but on average they only ate two thirds of the servings that they took. Change in preference is an improvement, but there are multiple influences on fruit and vegetable preference. A child's preference may change during the course of an intervention, but if a child's environment goes back to what it was before the intervention a change in preference is hard to maintain. While preference was not always an outcome that was measured or changed, a few programs demonstrated increased knowledge of healthy eating.

In the literature review literature conducted by Berezowitz (2015), of the four studies they reviewed that measured change in knowledge, two show the improvements in science and mathematics, it shows school gardens can increase children's knowledge in a number of areas, not just limited in nutritional knowledge. Ellsworth *et al.* (2015) found that in their farm- to- school intervention, nutritional knowledge increased from 58% to 74%. Evans *et al.* (2012) also found significant increase in knowledge from their "Sprouting Healthy Kids" intervention. Lastly, studies by Koch *et al.* (2006), Morris *et al.* (2002), Moss *et al.* (2013) and Smith *et al.* (2005) showed increase in knowledge from their garden- based interventions. In addition to children improving their knowledge surroundings nutrition and science in the garden, it is important to note that garden spaces for children are seen as effective learning laboratories for children, but schools still need the proper tools to implement these interventions properly.

In a survey conducted by Graham *et al.* (2005) among 4,194 California school principals, they found that the most common reason gardens were used was for nutrition, environmental studies and science. Principals strongly agreed that having curriculum on nutrition and academic instruction for the garden would assist in using the garden for academic instruction. Although this study was limited by a 43% response rate among principals, it showed a need for developing or utilizing a more comprehensive garden

curriculum for schools that could help assist schools with garden- based nutrition education programs and other benefit of garden- based nutrition education programs is their ability to provide healthy food and the supportive structure that allows children to make healthy choices. Chaufan*et al.* (2015) in their intervention titled "Garden of Eatin", works on the premise that nutritional practices develop over the life course. If a child develops healthy eating habits and practices at an early age, this can help combat childhood disease rates. Overall, participants reported having good health and being able to eat healthy, having fresh fruits and vegetables at the school supported their ability to eat healthy foods and fewer structural barriers to eating healthy foods (Evans *et al.*, 2015).

2.8. Theoretical frameworks underlying garden- based nutrition education intervention

In the world of nutrition education, theories aim to explain how our health behaviors are influenced. One theory that explains the influence health behavior is the social ecological model. This is a relevant theory that describes 5 different levels on which health- related behaviors have potential to be impacted. These levels are; intrapersonal, interpersonal, institutional, community and public policy (Ozer, 2007). Garden- based nutrition education programs vary, but they all encompasses practical educational activities that are taught in a growing environment with adult figures who are supporting the students learning.

According to the social – ecological model, a child's development is viewed as being nested within different micro- systems, that influence each other reciprocally to shape a child's development (Laird, 2016). The ecological principle of interdependence, which Kelly *et al.* (2000) describes, changes in one level of an ecosystem will produce changes in other levels of the ecosystem. This principle suggests that changes in one domain of the child such as nutrition, academic performance, self- efficacy and peer relationships may set in motion changes with other domains. There are multiple theories that explain how change can happen at each of levels.

The social cognitive theory is an emphasis on positive reinforcement and applicable to public health issues and it is often the theoretical framework of choice when it comes to nutrition and food interventions centered on youth (Berlin *et al.*, 2013). This theory is a good choice surrounding garden- based nutrition education intervention when considering the factors that influence food consumption patterns among children. With regards to many of the interventions examined in the literature review, personal factors tend to be operationalized as self- efficacy in regards to healthy food choices and interest, knowledge, and preferences in

regards to fruits and vegetables. Environmental factors are typically operationalized as household access to fresh fruits and vegetables and its consumption among the family. Berlin *et al.* (2013) details how Social Cognitive Theory constructs might apply to behavior change that incorporates healthier foods in garden- based nutrition intervention. Behavioral capability- youth having inappropriate knowledge and skills necessary to choose and consume more fruits and vegetables. Expectations- youth having the ability to value the results of consuming more healthy foods. Expectancies- youth having ability to value the results of consuming more healthy foods. Locus of control- youth perception of who controls and reinforces continued consumption of healthy foods. Reciprocal determination is the interaction between youth and their environment that results in consumption of healthier foods. Reinforcement is a response exhibited by youth in relation to consuming healthy food that increases the chances of this behavior being repeated; reinforcement is a construct that can be provided internally or externally. Self- efficacy is youth's confidence in their ability to consume more healthy foods. Emotional coping response is how youth deals and cope with anxieties that surround their consumption of healthy foods (Berlin *et al.*, 2013). It is important to note that main point of theory is that knowledge does not necessarily result in the targeted behavior, a child must have self- efficacy about that behavior (in this case healthy eating).

ADHD is a disorder characterized by symptoms of inattention, impulsive behavior and hyperactivity. Medication, Behavior therapy and modification of diet are the major intervention methods to treat ADHD. Several studies have shown that ADHD elimination diet with incorporating fruit and vegetable in diet shows an impact on the ADHD symptomatology. One of the methods of diet intervention is garden- based nutrition intervention. Several studies have shown that garden- based nutrition intervention has promising results in preference and consumption of fruit and vegetables. The literature review clearly demonstrates that Garden Based Nutrition Education can be considered as an intervention method which can enhance modification of diet to reduce the symptomatology in children with ADHD.

MATERIALS AND METHODS

CHAPTER: 3

MATERIALS AND METHODS

The present study makes an attempt to determine the impact of garden-based diet therapy on the ADHD symptomology of school going children with ADHD in a randomized control trial. A general description of methodology followed in the conduct of the study is presented in this chapter under the following heads:

3.1 Locality of the study

3.2 Selection of the sample

3.3 Tools for data collection

3.4 Conduct of study

3.5 Statistical analysis

3.1 LOCALITY OF THE STUDY

The locality of the study was at the Government Upper Primary School Poovachal, Cottonhill Government Girls Higher Secondary School, Government Model School, Thycaud all from Thiruvananthapuram district and Vimala Hridhaya Special School from Kollam district.

3.2 SELECTION OF SAMPLE

In the present study, the sample comprised of one hundred and three school children with ADHD symptoms both boys and girls in the age group of 6-12 years. The sample was screened based on the DSM IV diagnostic criteria and after interview with parents and teachers. Selection of the sample was based on inclusion and exclusion criteria. The sample were selected with the help of a developmental therapist. The inclusion and exclusion criteria were as follows:

3.2.1 Inclusion criteria

ADHD diagnosed according to DSM-IV
(Diagnostic and Statistical Manual of Mental Disorder).
Children aged between 6-12years.
Children not taking medication such as methylphenidate.
Sufficient command of Malayalam or English language

3.2.2 Exclusion criteria

Family circumstances hampering completion of the elimination diet;

Children already on a diet or been on a diet in the past two months.

Children receiving behavioural therapy or medication at the time of registration.

3.3 Tools for data collection

Success of every research study depends upon the use of appropriate and well-designed tools or techniques to elicit information from the sample and the following tools were used in the present study for assessment.

Assessment of ADHD Symptoms

24-hour dietary recall method

Food consumption pattern and food preference of the subjects

Participation Score Sheet

Anthropometric Measurements

3.3.1 Tool 1: Assessment of ADHD symptoms

Assessment of ADHD was based on structured interview using DSM IV Criteria, (Diagnostic and Statistical Manual of Mental Disorder 2013) based ADHD checklist (Appendix. I).

3.3.2 Tool 2: 24-hour dietary recall method

The 24-hour recall was obtained from each subject during the first week of the study as a way to measure food consumption pattern to elicit the food frequency and preference with reference to the elimination and restricted foods. This is a specific type of food diary that asks individuals to remember and record all of the food and beverages that they had consumed the previous day, where in children record their food intake on worksheets. The 24-hour recall method was used to determine the quantity of sugar, maida, chocolate, bakery items and fizzy drinks in their diet consumed by subjects. From the data collected by the recall method the raw equivalent of the foods consumed was computed. The respondents were asked about the types of food preparations, they had for breakfast, lunch, tea time and dinner and the raw ingredients used for each of the preparations and the quantity consumed by them was then assessed using the standardized cups. The cups were used to aid the

respondent to recall the quantities prepared and eaten. Later the raw food equivalents of the food consumed by the respondent were computed (Appendix. II).

3.3.3 Tool 3: Food consumption pattern of the subjects

3.3.2.1 Food preference

Food preference were measured using a four-point scale. Preference for sugar, maida, chocolate, bakery items and fizzy drinks were gauged through rating scales. The rating scale was selected as for assessment based on FAO guidelines for assessing nutrition-related Knowledge, Attitudes and Practices. Rating scales are mostly used in assessing the dietary habits and preferences. The present rating scale had items which elicited information through the diet survey; the details regarding food preference towards the eliminated or restricted foods were collected (Appendix. III).

3.3.2.2 Food frequency

In this study food use frequency was measured using a five-point rating scale. Sugar, maida, chocolate, bakery and fizzy drinks items (those frequently advertised through media) were listed down and respondent's use and frequency for each item was rated separately. The rating scale was prepared, pre-tested and standardized before administering among the subjects (Appendix.IV).

3.3.4 Tool 4: Assessment of Anthropometric measurement

Nutritional anthropometry is the measurement of human body at various age and levels of nutritional status, which provide nutritional status of individuals (Appendix V).

3.3.4.1 Height

The height of an individual is influenced both by genetic and environmental factors. Height is affected only by long term nutritional deprivation and it is considered as index of chronic or long duration malnutrition (Srilakshmi,2017).

To determine height, a measuring tape was fixed vertically on a smooth wall, perpendicular to the ground, taking care to see that the floor area was even and not rough. The subjects were asked to remove their foot wear and to stand with the centre of the back touching the wall, with feet parallel and heels, buttocks, shoulder and back of the head

touching the wall. The head was held comfortably erect, the arms hanging loosely by the side. A smooth, thin ruler was held on the top of the head centre, touching the hair at right angle to the wall and height read off from the lower edge of the ruler to the nearest 0.5cm. Each reading was taken twice to ensure correctness of the measurement.

3.3.4.2 Weight

Body weight is the most widely used sensitive and simplest reproducible anthropometric measurement. It indicates the body mass and is a composite of all body constituents like water, mineral, fat, protein, and bone. It reflects more recent nutrition (Srilakshmi, 2017).

For weighing, platform weighing balance was used as it is portable and convenient to use in the field. The scale was adjusted to zero before each measurement. The subjects having minimum clothing were asked to stand on the platform of the scale, without touching anything and look straight ahead. The weight was recorded to the nearest of 0.5kg. Each reading was taken twice to ensure correctness of the measurement.

3.3.4.3 Computation of body mass index

Body Mass Index (BMI) of the children was computed using the weight and height measurements. Body mass index of the participants was computed using the formula

BMI=Weight (kg)/Height(m2)

Based on the BMI the respondents were graded following the procedure cited by (Bamji*et al.*, 2017)

3.3.5 Tool 5: Participation score Sheet:

A participation score sheet was prepared to note the attendance, participation and discussion in each activity by the subjects in the intervention programme.

The frequency of their participation in these activities was assessed marking on 3-point scale; the scores were assigned as 0-3. When they attended, participated and discussed the education and games programme, the score given was "3". When they attended and participated, score "2" was given, those who only attended but not participated were given "1" and score "0" was given to those who did not attended at all. The scores were finally summed up to obtain an index. Maximum total score was given for Nutrition education

session and Gardening intervention was out of 99. Nutrition education session was divided into two i.e. Nutrition education class using multimedia tools and the Games session score for these activities were out of 45. Gardening intervention was divided into 6 activities i.e. Soil preparation, seed or crop selection, Sowing / planting the sapling and manuring, watering, protection and harvesting. Maximum Score for these activities were out of 54 (Appendix. VI).

3.3.5.1 Educational Tools Prepared to Conduct the Nutrition Intervention:

The following education tools were prepared to conduct the nutrition intervention

3.3.5.1.1 Multimedia tools

Diet counseling using power point Presentation: 30 min presentation was prepared to motivate the children and parents towards the consumption of fruits and vegetables. A PowerPoint presentation on the nutritional benefits on fruits and vegetables for children was also prepared.

3.3.5.1.2 Education Games and Fun tools (Appendix. VII)

Three games were developed for conducting nutrition intervention

Fruit Shadows

Fruit Necklace

Fill a bowl with fresh fruits.

3.4 Conduct of study

3.4.1 Pilot Study

Pilot study was undertaken to find out the reliability of the questionnaires, rating scale and check list to see if consistent results was obtained. Twenty students of the age group of 18 years were subjected to pilot study. The differently abled students undergoing horticultural therapy training programme at College of Agriculture, Vellayani were selected for pilot study. They were subjected to the questionnaire. The completed questionnaires were collected back on the same day. The Twenty students were subjected to the tools once again the next day and the questionnaire was collected on the same day. The scores of the two days were consolidated and were subjected to statistical analysis in order to find the reliability of the questionnaire. There was no significant difference between the two, hence the tools were considered to be reliable.

Table 2: Difference in the scores of Food frequency questionnaire for two days

Trials	Number	Mean	Standard deviation
1st day	20	3.29	0.849
2nd day	20	3.29	0.849

Table 3: Difference in the scores of Food preference questionnaire for two days

Trail	Number	Mean	Standard deviation
1st day	**20**	**3.49**	**0.527**
2nd day	**20**	**3.49**	**0.527**

3.4.2 Main Study:

The main study was done in three phases.

3.4.2.1 Pre-Intervention Assessments:

The initial tests included a biographical questionnaire to acquire details about the sample. The personal and socio-economic characteristics of the subjects were assessed using the questionnaire prepared. Assessment of ADHD, Anthropometric measurements, Dietary recall, ADHD behavior symptom were elicited.

3.4.2.2 Garden based Nutrition Intervention:

The garden-based nutrition intervention was conducted in the following steps.

3.4.2.2.1 Nutrition Education using Multimedia approach

A self-explaining power point presentation on the elimination diet and importance of fruits and vegetables was imparted to students selected for the study.

Plate 1: Screening of ADHD by Clinical Psychologist

Plate 2: Administering of the frequency and food preference questionnaire to the subjects by the investigator

3.4.2.2.2 Diet counseling to parents

Parents were given diet counselling in which the importance of healthy food intake and the harm of junk and sugar enriched foods was imparted. They were also given a diary for registering not only the behavior of the child but also for any dietary infractions. A diet chart was prepared to every child as per the RDA recommended by ICMR. The diet chart prescribed for each day included all food products the child could eat and drink (Appendix.VIII).

3.4.2.2.3 Raising a nutrition garden:

A self-explaining power point presentation on how to start gardening in a school was first shown to the children. The children were helped to raise a nutrition garden with the help of the teachers and a skilled laborer. The nutrition garden was raised at Government Upper Primary School Poovachal, Cottonhill Government Girls Higher Secondary School, Government Model School, Thycaud and Vimala Hridhaya Special School, Kollam in approximately five cents rectangular land. The plants were raised in sacks and gunny bags. The plants like tomatoes, lady's finger, brinjal, amaranthus, green chillies, cow pea, bitter gourd, cucumber, peas and papaya were raised. The mixture was prepared using coir pits compost, cow dung, neemcake and red loam soil. The mixture was filled in the sacks.

3.4.2.2.4 Maintenance and Protection of the raised garden:

The subjects selected for the intervention programme were asked to regularly maintain and protect the garden every day for two months. The participation of the subjects in the activities were recorded by the class teacher using the participation score sheet (Appendix. VI).

3.4.2.2.5 Harvesting:

The yield of the fruits and vegetables were reaped and collected by the children as a team. The participation in these activities were also recorded (Appendix. VI).

3.4.2.3 Post intervention assessment and single blinded measurements:

This assessment included record of ADHD behavior/ Symptoms, and 24-hour dietary recall, ADHD behavior symptom questionnaire was done after the intervention. All children were assessed independently by a development therapist and the researcher (Appendix. I, II, III and IV).

Plate 3: Diet counselling for parents imparted by the investigator

Plate 4: Garden Based Nutrition Education

"Raising a garden"

Plate 5: Maintenance of the garden

Plate 6: Harvesting

3.5 Statistical Analysis:

The data collected were scored, coded, consolidated and subjected to statistical analysis and interpretations. The statistical procedures used in the present study were non-parametric methods and Co-relational analysis to find out the impact of garden-based diet therapy.

RESULTS

CHAPTER: 4

RESULTS

In order to facilitate better understanding the findings of the present study are classified under the following sessions.

4.1. a. Distribution of subjects based on gender

b. Distribution of subjects based on age

c. Distribution of subjects based on height

d. Distribution of subjects based on weight

e. Distribution of subjects based on BMI

4.2.a Comparison of the pre-intervention ADHD score and post intervention ADHD score

b. Comparison of the pre intervention food preference and post intervention food preference

c. Comparison of the pre intervention food preference and post intervention food preference

4.3.a. Relationship between participation index score of gardening and nutrition education class with ADHD score

c. Relation of elimination of food items in the diet with ADHD score

4.1.a. Table 4: Distribution of subjects based on their gender (n=103)

Experimental group	**Gender**	**Frequency(N)**	**Percentage(%)**
	Male	50	94.33
	Female	3	5.66
Control group	Male	28	44
	Female	22	56

The results of table 4 indicate that there were 50 males and 3 females in the experimental group and 28 males and 22 females in the control group.

4.1.b. Table 5: Distribution of subjects based on their age (n=103)

Age (years)	**Experimental group (n=53)**		**Control group (n=50)**	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
8-9	7	13.2	15	30
10-11	33	62.3	24	48
12-13	13	24.5	11	22
Min	8		12	
Max	8		12	
Average	10.660		10.24	
SD	1.08		1.348	

Table 5 shows that among the subjects ,7 of them belonged to the age group 8 - 9 years, 33 of them belonged to the age group 10- 11 years and 13 of them belonged to the age group 12-13 years in experimental group and in control group, 15 of them belonged to the age group of 8-9 years, 24 of them belonged to age group of 9-10 years, 11of them belonged to age group of 12 -13years.

4.1.c. Table 6: Distribution of subjects based on their height (n=103)

Height (Cm)	**Experimental**		**Control**	
	Frequency (n)	**Percentage (%)**	**Frequency (n)**	**Percentage (%)**
130-134	17	32.07	15	30
135-139	29	54.71	20	40
140-144	5	9.43	12	24
145-149	1	1.88	2	4
150-154	1	1.88	1	2
Min	130.4		130.4	
Max	150.1		150	
Average	136.705		137.814	
SD	3.956		4.358	

Table no 6 shows that among the subjects, 17 subjects had a height in range of 130 to 134 cm, 29 subjects were in range of 135 to 139 cm, 5 subjects were in range of 140-144 cm, 1 subject was in the range of 145 to 149 cm and 1 subject was in the range of 150 to 154 cm in the experimental group, and in the control group 15 students were between 130-134cm, 20 were in the range of 135-139 cm, 12 of them were in the range of 140-144cm, 2 of them were in the range of 145-149cm and 1 student was in the range of 150- 154cm.

4.1.d. Table 7: Distribution of subjects based on their weight (n=103)

Weight (Kg)	Experimental		Control	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
25-30	3	5.66	2	4
31-35	21	33.96	21	42
36-40	16	30.18	12	24
141-45	12	22.64	15	30
46-50	1	1.88	0	0
Min	27		28	
Max	45.2		43	
Average	36.40		34.86	
SD	4.568		2.913	

Table no 7 shows that 3 of the subjects weighed between 25 to 30 kg, 21 subjects were in between the range 31 to 35 kg , 16 subjects were in the range of 36 to 40kg, 12 subject were in the range of 41 to 45 kg and only 1 subject was ranging between 46 to 50 kg in the experimental group and in the control group , 2 students were in the range of 25-30kg, 21 students were in the range 31-35kg, 12 students were in the range 36-40kg and 15 were in the range 41-50 kg.

4.1.e. Table 8: Distribution of subjects based on their BMI (n=103)

BMI	**Experimental**		**Control**	
	Frequency(n)	**Percentage (%)**	**Frequency (n)**	**Percentage(%)**
15-17	11	20.75	17	34
18-20	26	49.05	17	34
21-23	14	26.41	6	12
24-26	2	3.77	10	20
Min	15		15	
Max	25		23	
Average	19.509		18.44	
SD	2.342		1.875	

According to the results given in the table 8, it is observed that 11 subjects among the experimental group were in the BMI range 15 kg/m to 17kg/m which is underweight. 26 subjects were in the BMI range 18 kg/m to 20 kg/m which was normal, 14 subjects were in the range 21 kg/m to 23 kg/m which was overweight, 2 of them were in the range 24kg/m to 26 kg/m which is obese. In the control group, 17 subjects were in the range 15 kg/m -17 kg/m which was under weight, 17 subjects belonged to the range 18 kg/m -20 kg/m which was normal, 6 subjects belonged to the range 21kg/m -23 kg/m which was overweight and 10 subjects belonged to the range 24 kg/m-26 kg/m which was obese.

4.2.a. Table 9: Comparison of the Pre intervention ADHD score and Post intervention ADHD score

	Pre intervention ADHD score				**Post intervention ADHD score**			**Difference**	**t-statistics**	**t- critical (5%)**
Group	N	Min	Max	Average	Min	Max	Average			
Experimental	53	56	105	87.549	46.375	14.125	76.554	10.995	11.471**	2.006
Control	50	90	105	101.28	90	105	101.62	-0.34	-1.743	2.009

Level of significance = 5%

The table no 9 shows the comparison between the pre and post ADHD scores of Experimental and control groups and it was depicted that there was significant difference (0.273) in the ADHD scores from pre-assessment to post assessment in the experimental group. In control group there was no significant difference in the pre-ADHD and post ADHD score.

4.2.b. Table 10: Comparison of the Pre intervention food preference and post intervention food preference score

Group	Food items	Pre food preference	Post food preference	Difference	t-statistics	t-critical
Experimental	Sugar	3.735	3.075	0.66	6.139**	2.006
	Maida	3.716	3.528	0.188	3.477**	
	Chocolate	3.471	2.132	1.339	15.770**	
	Bakery items	3.471	2.132	1.339	15.770**	
	Fizzy drinks	3.603	1.716	1.886	18.950**	
Control	Sugar	3.78	3.78	0	0	2.009
	Maida	3.88	3.54	0.34	4.628**	
	Chocolate	3.82	3.52	0.3	4.2**	
	Bakery items	3.9	3.88	0.2	0.573	
	Fizzy drinks	3.94	3.88	0.06	1	

(Level of significance = 5%)

The table 10 shows that there was a significant difference (0.273) in the pre-intervention food preference score and the post intervention food preference score for sugar, maida, chocolate, bakery items and fizzy drinks in the experimental group. In the control group, there was a significant difference (0.273) between the pre-intervention food preference score for maida, chocolate, but there was no significant difference in the pre and post intervention preference score for sugar, bakery items and fizzy drinks.

4.2.c. Table 11: Comparison of Pre-intervention and Post intervention food use frequency score

Group	Food items	Pre food frequency	Post food frequency	Difference	t-statistic	t-critical
Experimental	Sugar	4.301	4.150	0.150	2.672**	**2.006**
	Maida	4.339	3.943	0.396	4.187**	
	Chocolate	3.905	2.018	1.886	21.451**	
	Bakery items	3.943	2.018	1.924	19.930**	
	Fizzy drinks	4.528	3.981	0.54	6.565**	
Control	Sugar	4.34	4.4	-0.06	-1.352	2.009
	Maida	4.26	4.14	0.12	1.231	
	Chocolate	4.38	4.18	0.2	3.5**	
	Bakery items	4.42	4.48	-0.06	-0.724	
	Fizzy drinks	4.08	4.28	-0.2	-2.857	

(Level of significance= 5%)

The Table no 11 shows that there was significant difference (0.273) in the pre-food frequency and post food frequency of sugar, maida, chocolate, bakery items and fizzy drinks among the experimental group. Similarly, in the control group, significant difference (0.273) was found among pre-food frequency and post food frequency of chocolate. But no significant difference was found in the pre and post food frequency score of sugar, maida, bakery items and fizzy drinks.

4.3.a. Table 12: Relationship between the ADHD score and participation index score of gardening and nutrition education class

Participation index score	**Change in ADHD score experimental**	**Change in ADHD score of control**
Gardening	0.695**	
Nutrition education session	0.717**	- 0.102

(Level of significance = 5%)

It is depicted in table 12 that there was a significant correlation between participation index score of gardening and nutrition education session with the ADHD score in the experimental group. When the participation index score increases, the ADHD score has been decreased. In the control group there was no significant correlation between the participation index score of nutrition education session with the ADHD score.

4.3.c. Table 13: Relation of elimination of food items in the diet with ADHD score

Group	Food items	Correlation	Significance
Experimental	Sugar	0.598	6.65**
	Maida	0.775	13.85**
	Chocolate	0.614	7.038**
	Bakery items	0.427	3.732**
	Fizzy drinks	0.365	3.007**
Control	Sugar	-0.085	-0.059
	Maida	-0.144	-0.997
	Chocolate	-0.002	-0.013
	Bakery items	-0.176	-1.219
	Fizzy drinks	0.065	0.004

(Level of significance = 5%)

The table 13 depicts the relation between the elimination of food items and the ADHD Score. It is clearly shown that sugar, maida, chocolate, bakery items and fizzy drinks if eliminated from the diet shows significance correlation (0.273) with ADHD score. It is seen that higher the elimination score, lower the ADHD score in the experimental group. In the control group, elimination score of sugar, maida, chocolate, bakery items and fizzy drinks shows no significant correlation with the ADHD score.

DISCUSSION

CHAPTER: 5

DISCUSSION

This chapter presents, explores, describes and discusses the results of the study "Garden based diet therapy for school going students with Attention Deficit Hyperactivity Disorder". In order to facilitate better understanding and for convenience the discussion of the results of the present study are presented under the following sessions.

5.1. a. Distribution of subjects based on gender

b. Distribution of subjects based on age

c. Distribution of subjects based on height

d. Distribution of subjects based on weight

e. Distribution of subjects based on BMI

5.2.a Comparison of the pre-intervention ADHD score and post intervention ADHD score

b. Comparison of the pre-intervention food preference and post intervention food preference score

c. Comparison of the pre-intervention food frequency and post intervention food frequency score

5.3.a. Relationship between participation index score of gardening and nutrition education class with ADHD score

b. Relation of elimination of food items in the diet with ADHD score

5.1.a. DISTRIBUTION OF SUBJECTS BASED ON THEIR GENDER

The results in table no 3 and figure no 1 shows that in this study there were 50 males and 3 females among the experimental group and 28 males and 22 females among the control group. In the present study when the samples were screened using DSM VI criteria, a greater number of boys were found to have ADHD. The experimental group was selected using purposive sampling and was screened from schools which had a garden and the students were participating in the garden. Several studies have shown that boys are three times more likely to receive an ADHD diagnosis than girls. (Biederman *et al.*, 2002; Boyles, 2004; Biederman*et al.*, 2004 and Novik*et al.*, 2006)

Similar results were seen in yet other studies which revealed that the prevalence of attention-deficit hyperactivity disorder (ADHD), or hyperkinetic disorder (HKD), is greater in males than females (Newcorn*et al.*,2001). It is also seen in several studies that ADHD is more commonly diagnosed in adult males compared with adult females (Fayyad *et al.*, 2017 and Ebejer *et al.*, 2012). A worldwide meta-regression analysis of 11 studies of adults with ADHD found that although the ratio of males to females with ADHD decreased with age, a gender difference was still present in adults aged 19 years and over (Biederman *et al.*, 2012).

There has been a fair amount of debate about whether the preponderance of males with ADHD is due to diagnostic bias, the notion being that boys are just more disruptive than girls so their symptoms are more obvious. Study also show that genetic risk factors which occur commonly in lots of people known as single nucleotide polymorphisms is also the cause of ADHD which is more found in boys than girls (Thapar and Cooper, 2016). Study results suggest that genetic risk factors which occur less commonly – or some other factors – may contribute to the lower rates of ADHD diagnosis in girls (Biederman, 2002).

Studies also have shown that boys with ADHD usually show externalized symptoms, such as running and impulsivity (Newcorn, 2001). Girls with ADHD, on the other hand, typically show internalized symptoms. These symptoms include inattentiveness and low self-esteem. Boys also tend to be more physically aggressive, while girls tend to be more verbally aggressive. However, the large European ADORE study of clinically referred children (n=1478; mean age: girls=8.8 years, boys=9.0 years) found no evidence to suggest that core ADHD symptomatology differed between genders (Fayyad *et al.*, 2017)

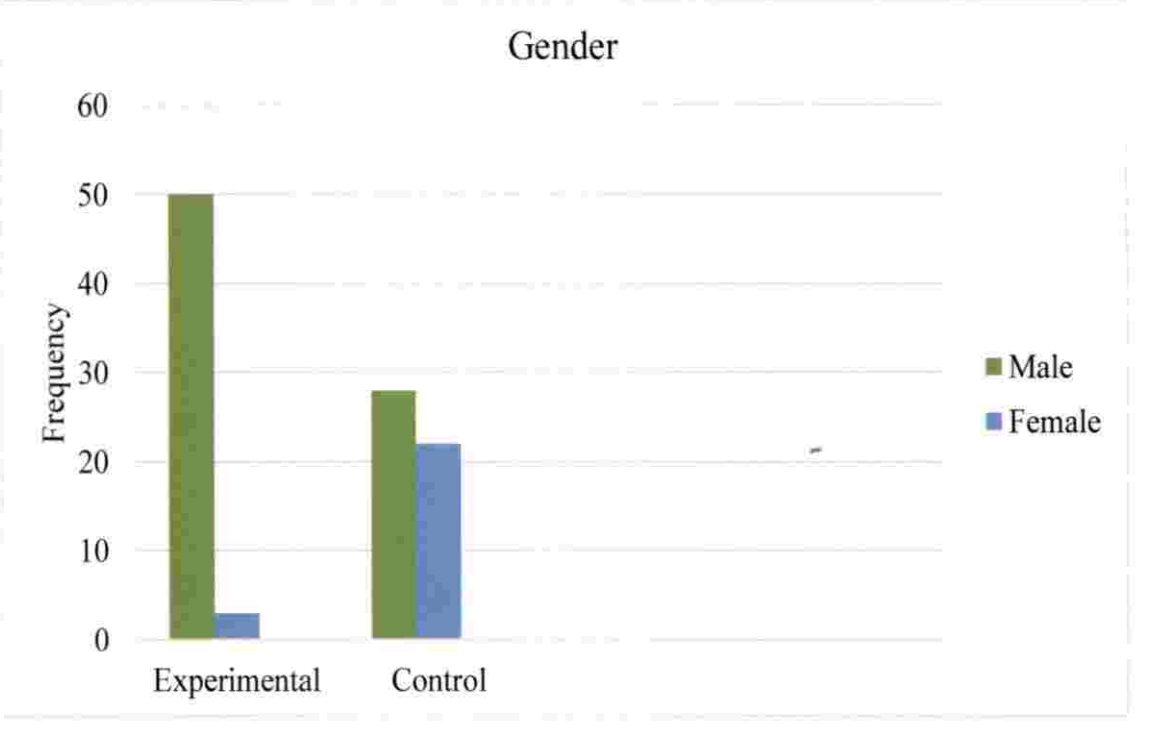

Figure: 1 Distribution of subjects based on gender

5.1.b. DISTRIBUTION OF SUBJECTS BASED ON THEIR AGE

In the present study out of hundred and three, thirty-three students with ADHD belonged in the age group of 10 to 11 years. A study by Ramtekkar, *et al* (2011) showed that age sometimes had a significant effect on the likelihood of a specific DSM-IV-like ADHD subtype for individuals in a particular age group. For instance, older age was significantly associated with current inattentive subtype diagnosis in children, while younger age was associated with current inattentive subtype diagnosis in adults. Also, younger age was associated with current combined subtype in adolescents. Older age at screener was a significant predictor of screener-based lifetime DSM-IV-like ADHD diagnosis in children, and younger age at screener was a significant predictor of screener-based lifetime DSM-IV-like ADHD diagnosis in adults. Studies also has shown that the age group 10 to 12 years is the period when the symptoms of ADHD are easily diagnosed (Brown, 2001), and it is also seen in this study that majority of the students were in the age group of 10 to 11 years.

5.1.c. DISTRIBUTION OF SUBJECTS BASED ON THEIR HEIGHT

The present study reveals that the majority of the subject's height was between 136 to 140 cm. As per the ICMR, the average weight for 9 to 12 years is 137.5. to 156.9 (I.C.M.R. 1990.) Studies have shown that the height of the children with ADHD is similar to their counterparts (Mariano et al., 2018). Studies have also shown that even the medication for ADHD like methylphenidate did not bring any changes in the height of children with ADHD (Sawnson et al., 2007). It is also reported that stimulants in food had effects on height of ADHD children (Faraone et al., 2008). These observations justify the result obtained in the present study.

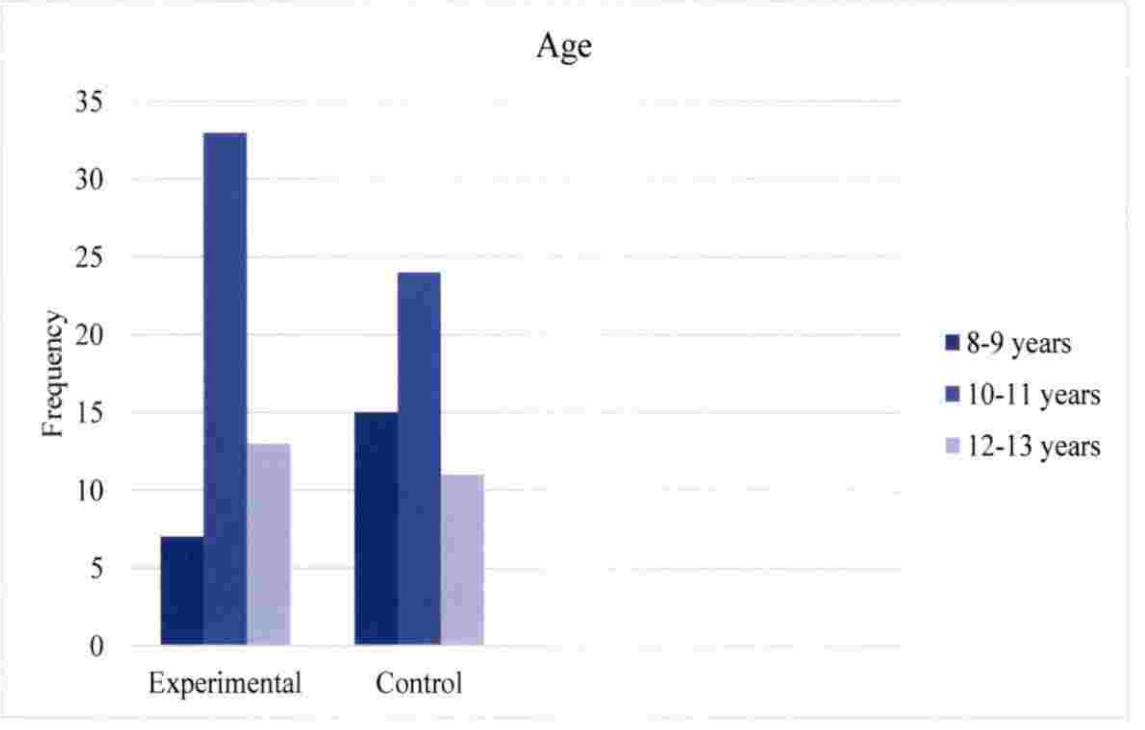

Figure 2: Distribution of the subjects based on age

5.1. d. DISTRIBUTION OF SUBJECTS BASED ON WEIGHT

The present study revealed that, 21 subjects' weight was in the range 31 to 35 kg. The average weight of Children of age group 10- 11 as per ICMR (2019) ranges between 28 to 40 kg. The subjects belonged to this range were found to be obese, overweight or underweight. Several studies showed that ADHD is a risk factor for obesity and overweight in children (Holtkamp et al., 2004; Kim et al., 2011; Fliers et al., 2013 and Yang et al., 2013).

5.1. e. DISTRIBUTION OF SUBJECTS BASED ON THEIR BMI

According to the results shown in the table7 and figure 2 it reveals that 11 subjects among the experimental group comes under the BMI range 15 to 17 kg/m which is underweight. 26 subjects fall under the range 18 to 20 which is normal ,14 subjects fall in the range 21 to 23 which is overweight, 2 of them are in the range 24 to 26 kg/m, which is obese. In the control group, 17 subjects fall under the range 15-17 which is under weight, 17 subjects were to the range 18-20 which is normal, 6 subjects were in the range 21-23 which overweight and 10 subjects were in the range 24-26 which is obese.

Several studies reported that there is an association between ADHD and obesity; therefore it is important when considering ADHD treatment (Chen *et al.,* 2010). Stimulant medications (e.g., methylphenidate and amphetamine compounds) are indicated for most cases. The most frequent side effects include decreased appetite, abdominal pain, headaches, irritability, and sleep disturbances. Rare side effects include weight loss, tics, social withdrawal, and emotional changes (Agranat*et al.,* 2005).

Studies show that reduced brain dopaminergic activity plays a central role in ADHD pathophysiology, predisposing these individuals to reward-deficiency syndrome (Graziano *et al.,* 2012). As it occurs in alcohol and drug abuse, high-calorie food consumption can activate dopaminergic pathways, therefore, overeating for ADHD patients is to compensate, at least temporarily, for dopamine deficits which can be the reason for overweight and obesity occurrence in the Children with ADHD (Davis, 2009 and Pagoto*et al.*, 2009).

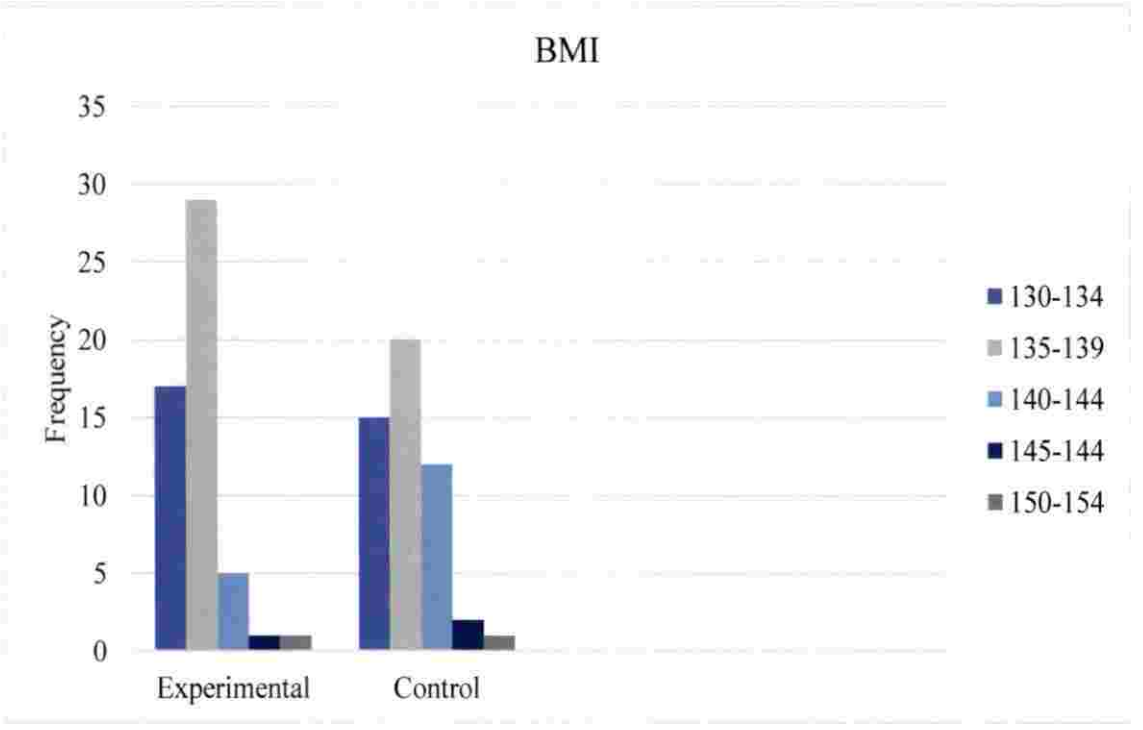

Figure 3: Distribution of subjects based on BMI

5.2.a COMPARISON OF THE PRE INTERVENTION ADHD SCORE AND POST INTERVENTION ADHD SCORE

The present study shows a difference between the pre and post ADHD scores of experimental and control group and it depicts that there is significant difference in the ADHD score from pre assessment to post assessment in the experimental group. In the control group there is no significant difference in the pre-ADHD and post ADHD score. The experimental group were subjected to nutrition education and gardening activities. The knowledge about certain food that triggers the attention deficiency and hyperactivity was imparted to parents in the nutrition education programme. The awareness created among the parents might have led to the decrease in the consumption of the food that triggers the ADHD symptoms among the children. By participating in the gardening activities, the hyper impulsivity and hyper activity in children might have reduced as the energy in the child has been channelized to productive work.

Gardening based nutrition education imparted to the children also can have developed a liking towards fruits and vegetables. Consumption of healthy food and participating in productive activity like gardening together has led to the decrease in the ADHD symptoms in the experimental group. However, the results also show that there is no change seen in the control group which could be because the group did not receive garden-based nutrition education.

Several studies have shown that garden-based nutrition education promotes healthy consumption (McAleese and Rankin, 2007). Similarly, there are many studies showings that when parents of children with ADHD are provided with nutrition education, the ADHD symptoms in children have reduced (Hurt *et al.*, 2001and Pelseer,2009). There are research evidences showing that certain food affect the behavior of children with ADHD (Rucklidge, 2001; Pelsser, 2005 and Scnoll*et al.*, 2003) Few studies suggest that children with ADHD and sub-clinical deficiencies of zinc may benefit from supplementation. Two types of interventions, few foods diets and fish oil supplementation, seem to hold some promises with respect to reducing ADHD symptoms. Several studies have shown that few foods diets appear to have a consistently positive effect in the short-term in some children with ADHD (Bloch, 2011; Pelsser, *et al.*, 2011).

Therefore, the results of the present study establish that ADHD symptoms were reduced when garden-based nutrition education was imparted to children with ADHD.

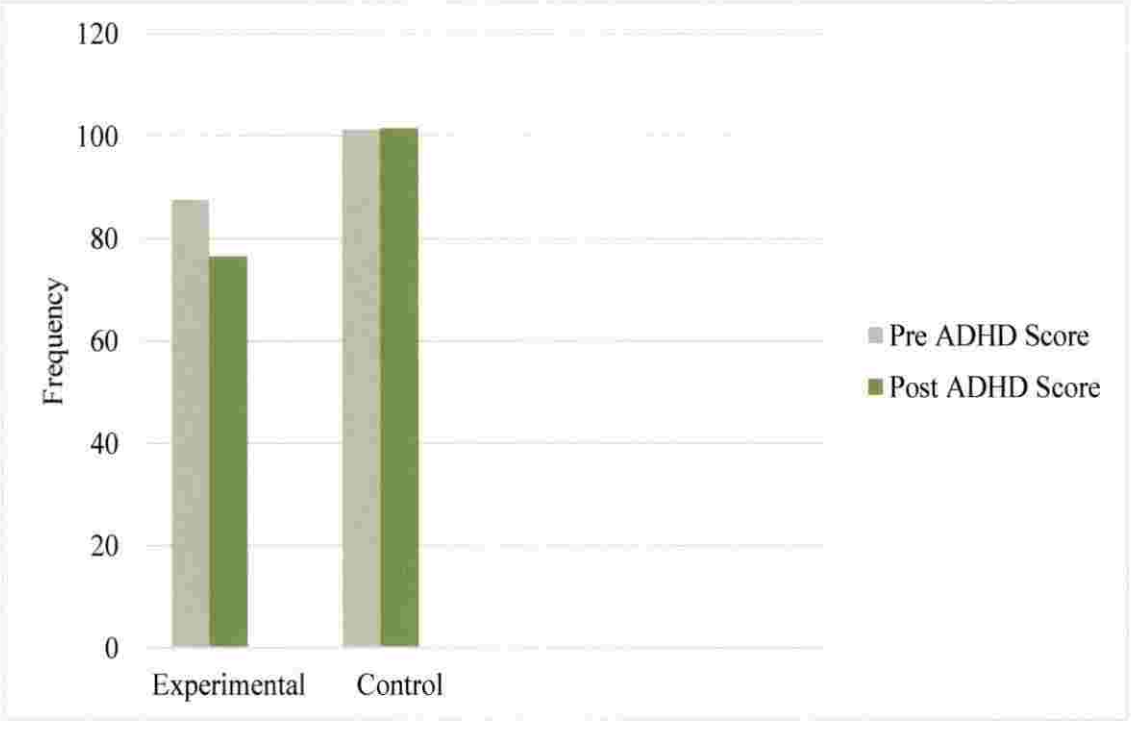

Figure 4: Comparison of the Pre intervention ADHD score and Post intervention ADHD Score

5.2.b. COMPARISON OF THE PRE-INTERVENTION FOOD PREFERENCE AND POST INTERVENTION FOOD PREFERENCE

The present study shows that there is difference between the pre and post intervention food preference of experimental and control group. It also depicts that there was significant difference in the pre and post food preference score in the experimental group. In the control group there was a significant difference in the pre and post preference score of maida and chocolate, but there was no significant difference in the pre and post preference score of sugar, bakery items and fizzy drinks. The experimental group were subjected to nutrition education session and gardening and also there was a diet counseling for parent about nutrition and food that triggers ADHD symptoms. This awareness bought a decrease in the preference of sugar, maida, chocolate, bakery items and fizzy drinks from the diet of experimental group. Whereas the control group were only subjected to nutrition education session and parents were given diet counseling. The parental diet counseling might be the reason for a significant difference in the food preference of maida and chocolate observed in the control group. Nutrition games were also prepared to bring participants more closely to the fruits and vegetables. The games might also have contributed to the impact on the positive change towards food preference among the treatment group of children.

Garden based nutrition intervention has many benefits in the realm of nutrition education especially in nutrition knowledge and preference. There are several studies reporting changes in attitudes and a willingness to taste vegetables after garden-based nutrition intervention on (Cason, 1999; Morris *et al.*, 2002; Morris and Zidenberg-Cherr, 2002).

Several studies have shown that nutrition education and intervention increase the nutrition knowledge of the subjects (Morris *et al.*, 2002; Razeena, 2000; McAleese and Rankin, 2007). The results obtained in the present study are supported by all the studies quoted above.

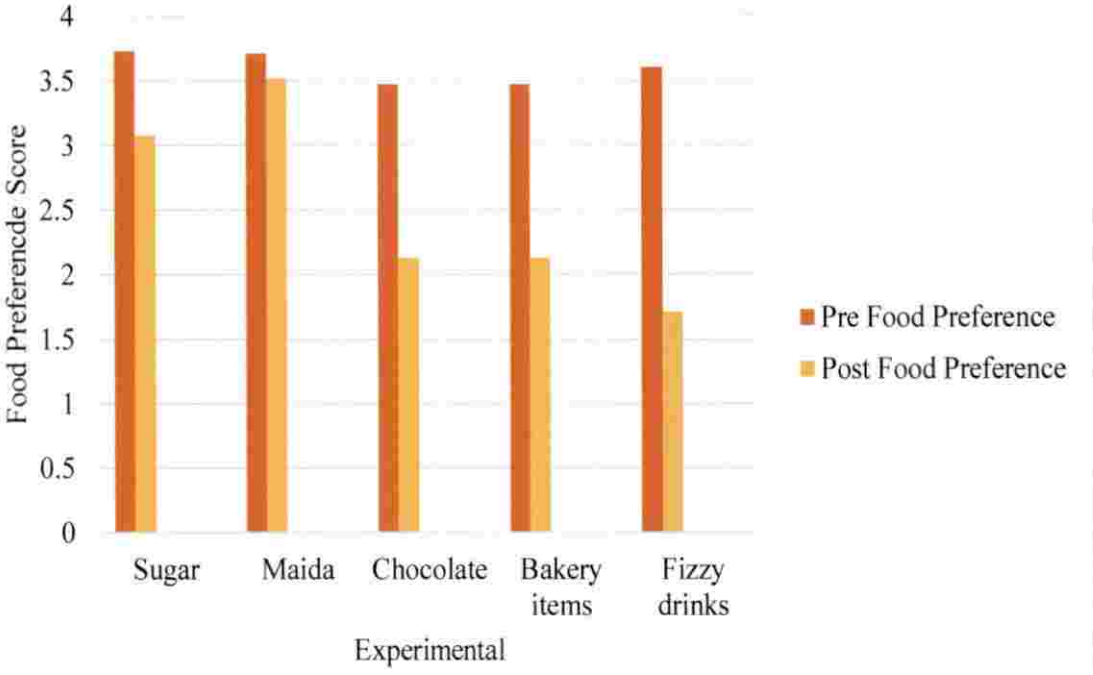

Figure 5: Comparison of the Pre intervention food preference and Post intervention food preference in experimental group

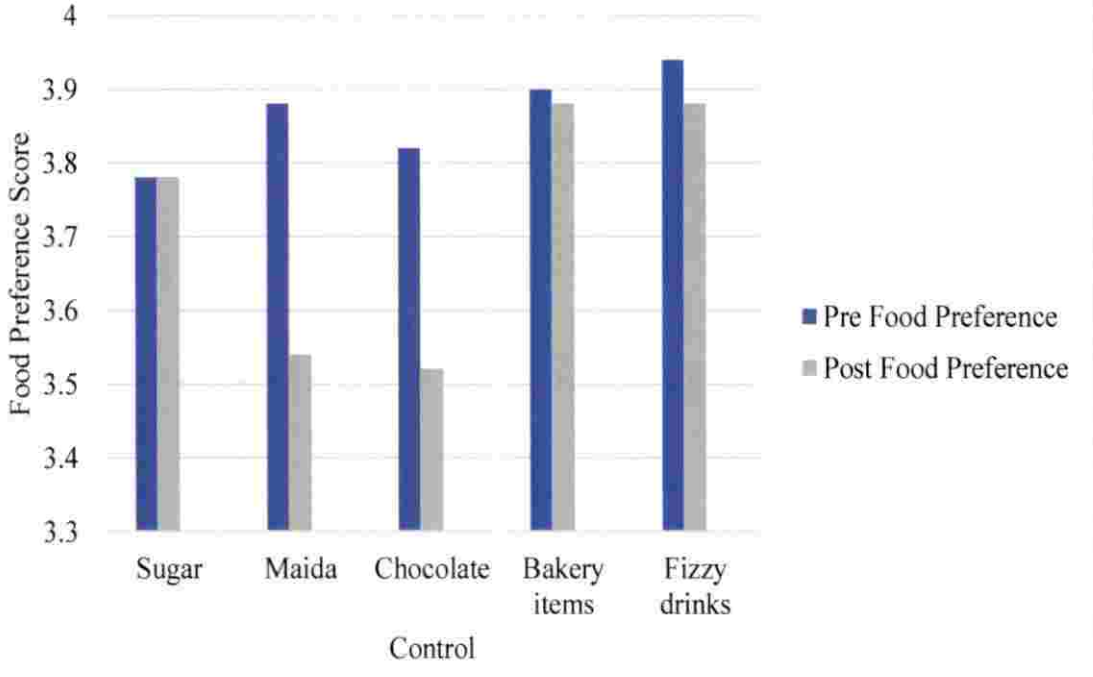

Figure 6: Comparison of the Pre intervention food preference and Post intervention food preference in control group

5.2.c. COMPARISON OF THE PRE-INTERVENTION FOOD FREQUENCY AND POST INTERVENTION FOOD FREQUENCY

The present study shows the difference between the pre and post intervention food frequency scores of experimental and control groups. The results revealed that there was a significant difference in the pre and post food frequency scores in the experimental group. In the control group there was a significant difference (P value) in the pre and post frequency score of chocolate, but there was no significant difference in the pre and post frequency score of sugar, maida, bakery items and fizzy drinks. The experimental group were subjected to nutrition education session and gardening and also diet counseling for parents about nutrition and food that triggers ADHD symptoms was imparted. This awareness brought a decrease in the frequency of sugar, maida, chocolate, bakery items and fizzy drinks from the diet of experimental group. The control groups were subjected to nutrition education session and parents were given diet counseling and this could be the reason for a significant difference observed in the food 12 frequency of chocolate. Due to the awareness of the consequences of the intake of chocolate, the parents would have resisted in buying chocolates and hence the frequency of chocolate consumption has decreased even in control group. Yet another study conducted in Kerala revealed that diet intervention reduces the consumption of sugar, chocolate and bakery confectionaries (Beela and Raji, 2017).

Similarly, in another study itwas reported that imparting nutrition education to school children has improved their knowledge on healthy eating habits (Kumar *etal.*, 2003). Nutrition education is able to increase nutritional knowledge and cause positive attitude to change towards healthy eating (Contento*etal.*, 1992). All these studies support the results obtained in the present study.

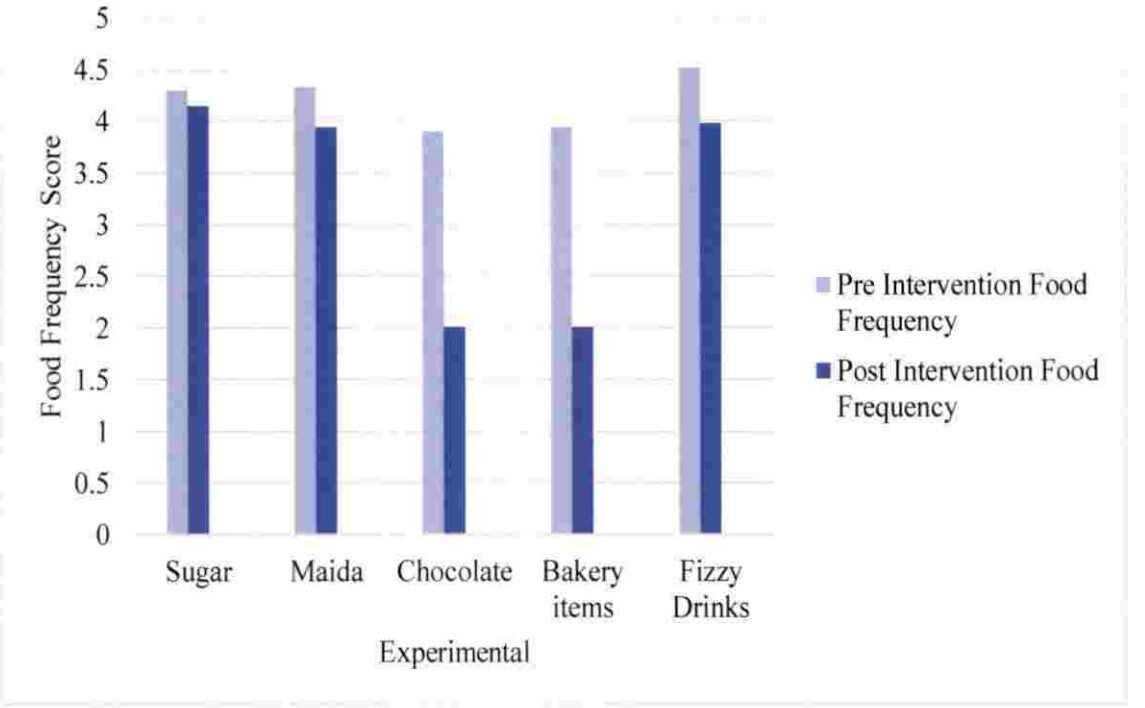

Figure 7: Comparison of the Pre intervention food frequency and Post intervention food frequency in experimental group

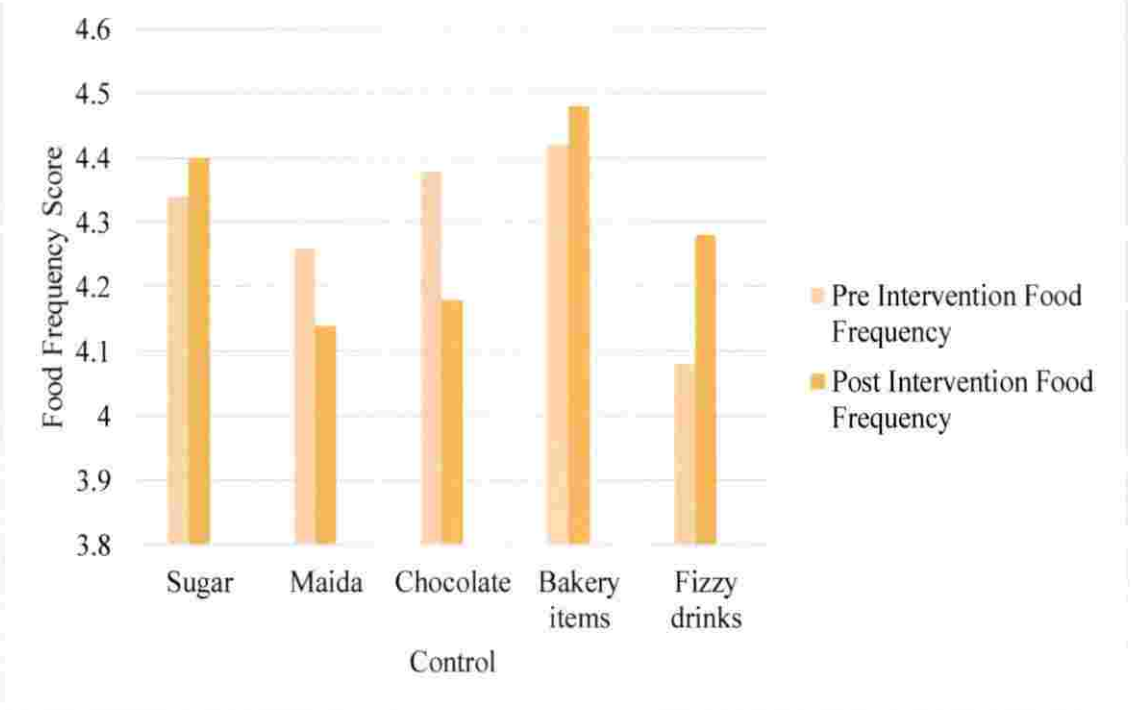

Figure 8: Comparison of the Pre intervention food frequency and Post intervention food frequency in control group

5.3.a. RELATIONSHIP BETWEEN PARTICIPATION INDEX SCORE OF GARDENING AND NUTRITION EDUCATION CLASS WITH ADHD SCORE

Results of present study results reveals that there was a significant relation between the participation index score of gardening (0.695**) and nutrition education (0.717**) at five percent level in the experimental group. When the participation scores of gardening and nutrition education session increased, the ADHD score has decreased. In the control group, who were given only nutrition intervention, showed no significant relation with ADHD score. When the participation score of nutrition education decreased, ADHD score increased.

Several studies have shown that students who participated in nutrition intervention with gardening improved their frequency of fruits and vegetable (Lineberger and Zajicek, 2000; Genzer*etal.*, 2001; Nolan, 2005) which justifies the results obtained.

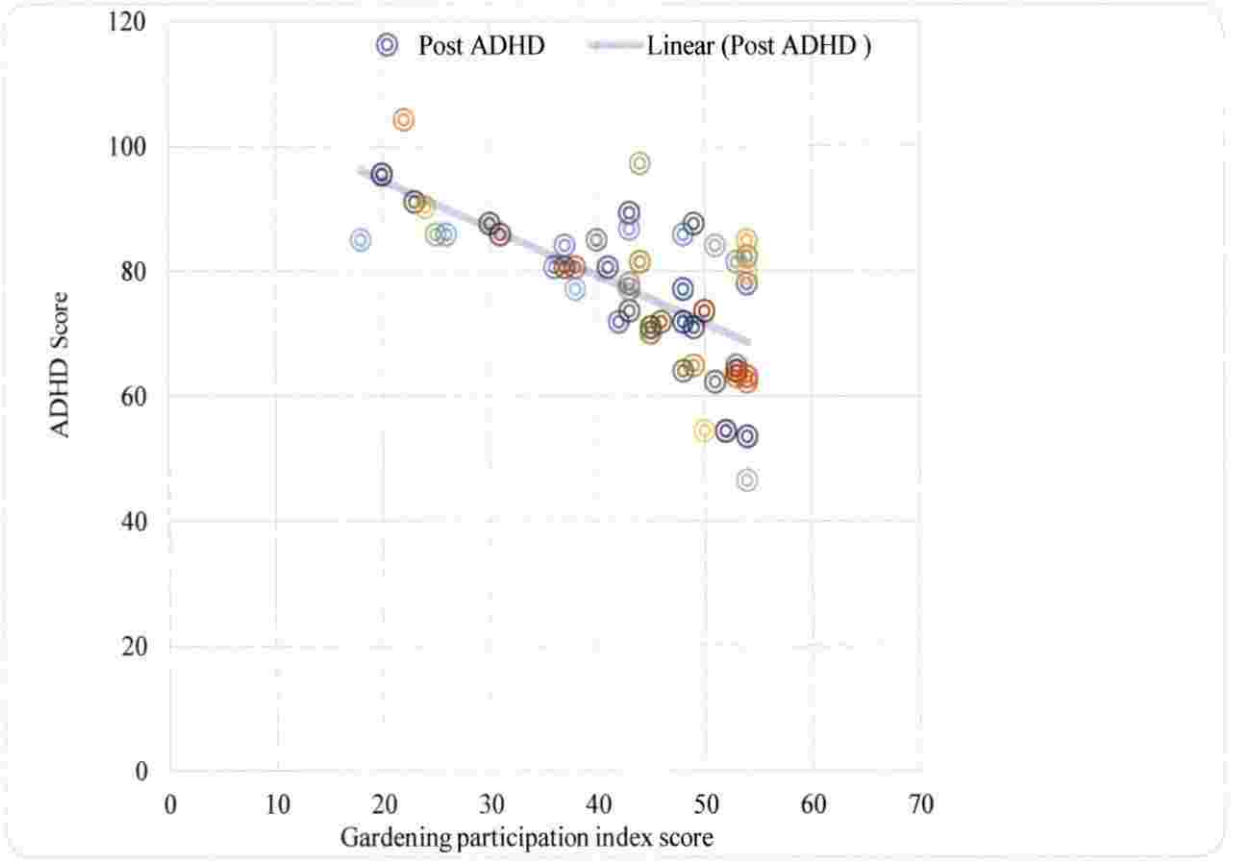

Figure :9 Relation between Gardening Participation Index and Post intervention ADHD Score in Experimental group

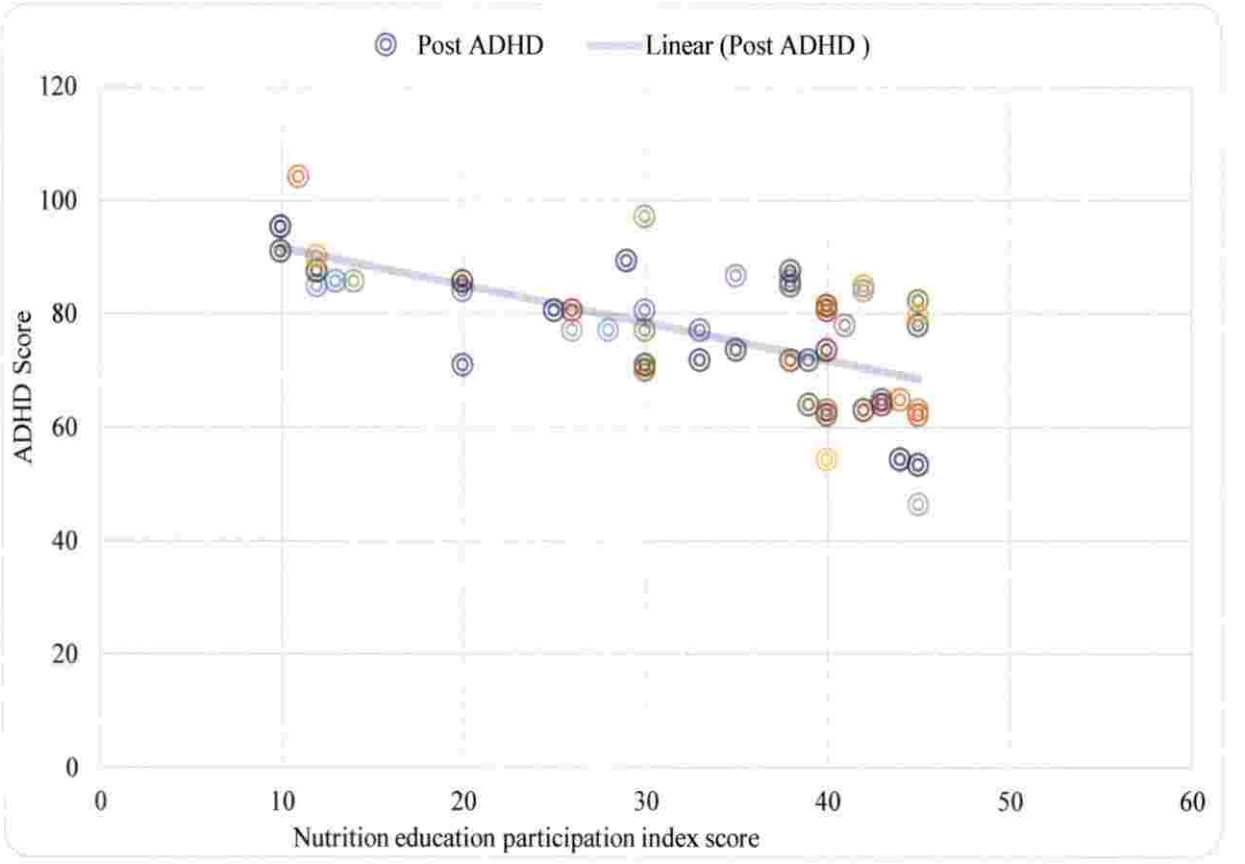

Figure: 10 Relation between nutrition education Participation Index and Post intervention ADHD Score in Experimental group

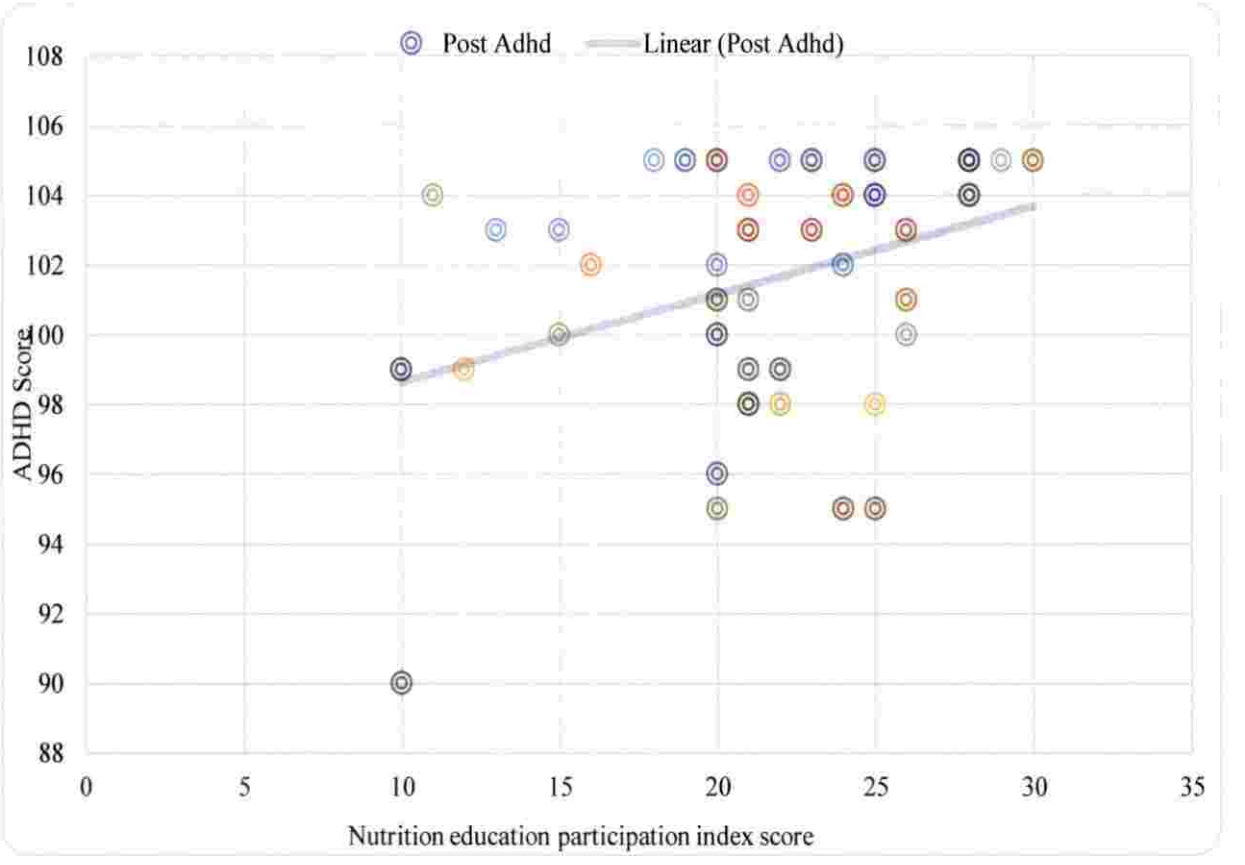

Figure :11 Relation between nutrition education participation index score with Post intervention ADHD Score in control group

5.3.b. RELATION OF ELIMINATION OF FOOD ITEMS IN THE DIET WITH ADHD SCORE

The present study revealed that there was a significant correlation between elimination of food items in the diet with ADHD score in experimental group. In the control group there was no significant relation between the elimination of food items with the ADHD score.

Studies show that nutrition plays an important role in neurodevelopment and this insight has led to increasing research into the efficacy of nutrition-related interventions for treating neuro developmental disorders like ADHD (Verena *et al.*, 2017). Bale *et al.* (2010) in their study revealed that one of the potential environmental risk factors for neurodevelopmental disorders is diet. Several studies reveal that nutrition has an impact on neurodevelopment, cognition, and behavior, and could therefore play an important role in neurodevelopmental disorder (Ho^tel-Dieu and Notre-Dame, 2004; Dauncey, 2009 and Goyal *et al.*, 2015).

Studies have shown that elimination of few food items from diet like sugar, maida, chocolate, bakery items and fizzy drinks has decreased ADHD symptoms. Goldman *etal.*, (1986) and Benoist et al., (2004) in their study proved that refined sugar has adverse effects on the behavior of children. A study reported 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 (Beela and Raji, 2017).

There are several studies which reported that elimination of restricted food items from the diet of ADHD will reduce ADHD symptoms in children (Carter *et al.*, 1993; Pelsser*et al.*, 2011; Stevens *et al.*, 2011 and Nigg*et al.*, 2012). A thirty-five-year study by Laura *et al.* (2010) showed that there is a relation between ADHD and diet.

The effectiveness of the food additives exclusion diet as treatment for ADHD has been investigated in a number of studies (Kanarek, 2011; Sonuga-Barke*et al.*, 2013 and Stevenson *et al.*, 2014). Only some studies additionally eliminated food items containing natural salicylates as part of a broader diet, such as the Feingold diet or Kaiser Permanent diet

(Harley *et al.*, 1978 and Conner *et al.*,1976). Stevenson *et al.* (2014) reported that high quality studies showed an effect size of 0.21 and 0.22 of food color elimination; however, these studies were not restricted to children diagnosed with ADHD. It has been suggested that the effect of food color elimination on behavior is probably not limited to children with a diagnosis of ADHD, but rather also applies to hyperactive behavior in children more generally (Kanarek, 2011).

Evidences from research has found that some of the items in food influences ADHD symptoms. Supplementation with omega 3 fatty acids, iron, zinc, magnesium, PUFA reduces ADHD symptoms in ADHD children and certain foods like n 3 fatty acid, Alpha lipoic acid etc alleviates ADHD symptoms.

Studies reveal that deficiency of polyunsaturated fatty acids (PUFA) in diet and the human body contribute, for example to dysfunction of nervous system and brain functioning (Klaudia*et al.*, 2012). Findings of many studies show, that children with Attention Deficit Hyperactivity Disorder have a low level of n-3 PUFA (Hibbeln*et al.*, 2007 and Joshi *et al.*, 2006). Konofal*et al.*(2004) in their study shows that iron deficiency in childhood was reported to affect the central nervous system, leading to mental retardation and behavioral disorder Konofal *et* al., (2007) proves that there is a significant association between iron deficiency, increased ADHD symptoms.

Studies reveals that zinc supplementation was significantly more effective in reducing ADHD symptom. (Claudia et al., 2012) Mousain- Bosc *et al.* (2004) reported a close relationship between magnesium deficiency and ADHD symptoms. Study reveals that magnesium deficiency often occur in children with ADHD (Nogovitsina and Levitina, 2007).Gordon and Michelle, (2012) that Omega−3 supplement is the latest dietary treatment with positive reports in reducing ADHD symptoms. Hibbeln*et al.*, (2007) and Joshi *et al.*, (2006) reported that diet rich in n 3 fatty acids may alleviate the symptoms of hyperactivity in children Bateman *et al.* (2004) showed a relationship between the intake of preservatives and food dyes increasing the symptoms of ADHD.

SUMMARY AND CONCLUSION

CHAPTER: 6
SUMMARY AND CONCLUSION

The present study entitled "Garden based diet therapy for school going students with Attention Deficit Hyperactivity Disorder" was conducted with an objective to determine the impact of garden-based diet therapy on the ADHD symptomatology among school going children with ADHD in a randomized control trial.

The garden-based diet therapy included gardening intervention, nutrition education intervention using multimedia tools and games. This research was conducted in school going students in the age group of 6-12 years. The samples were selected using purposive sampling method from Government Upper Primary School, Poovachal, Government Girls Higher Secondary School Cottonhill, Government Model School, Thycaud from Thiruvananthapuram district and Vimala Hridhaya Special School from Kollam district.

Tools were prepared to ascertain the assessment of ADHD symptoms, anthropometric measurements, 24-hour dietary recall, food frequency and food preference. The validity of tools were determined in the pilot study.

The majority of students were males (50) and only 3 females were there in the experimental group, whereas there were 28 males and 22 females in the control group. Majority of students with ADHD were in the age group of 10 to 11 years. When the height and weight of the subjects was analyzed, majority of the subjects had height between 136 to 140 cm and majority of the subjects had the weight between 31-35kg. Majority of students had BMI 15-17 which was underweight and 18-20 which is normal BMI.

The present study was carried out in three phases, the first phase was the pre intervention were the assessment of ADHD symptoms, anthropometric measurements, 24 hours dietary recall, food frequency and food preference was done. In the second phase gardening-based nutrition intervention was given were diet counseling for parents, nutrition education for students, different gardening activities were imparted. Finally, in the third phase, the post intervention assessment was done, where again the assessment of ADHD symptoms, food frequency and food preference scores were obtained.

The present study reveals that there was a decrease in the ADHD score after the gardening-based nutrition intervention. The study also reveals that there was a decrease in the frequency of consumption and preference of sugar,maida, chocolate, bakery items and fizzy drinks after the intervention in the experimental group. In the control group, who were given only nutrition education, showed a decrease in the preference of chocolate and decrease in the frequency of consumption of maida and chocolate was observed. The participation index score of nutrition education and gardening showed a significant correlation with the ADHD score in the experimental group. In the control group no significant correlation was found between the participation index score of nutrition education with the ADHD score.

The results also revealed that the experimental group had decreased the consumption of sugar, maida, chocolate, bakery items, and fizzy drinks in the experimental group.The results also revealed that there was a decrease in ADHD symptoms after the gardening based diet therapy. The intervention program had a significant effect on the change in the preference and frequency of sugar, maida, chocolate, bakery items and fizzy drinks.

In summary, the study showed association between gardening activity and ADHD symptoms. The study also revealed that low consumption of unhealthy diet and ADHD symptoms was related to reduced symptoms. This study also provide evidence that low consumption of unhealthy diet and garden-based nutrition education might play a big role in reducing the, symptoms of ADHD among the school going children diagnosed with ADHD. Therefore, this research finding might bring some new information that both garden-based nutrition education and low consumption of unhealthy diet can be beneficial for individual with ADHD and especially individuals, with ADHD who have other problems concerning mental health. This might be an effective augmentation to medication for those who do not response to medication or those who search for other treatment s than medication. Despite this positive evidence, this research is limited and therefore requires caution regarding interpretations.

The research was a cross-sectional study and therefore the causal relationship cannot be determined. The strength in this study is that the population included only students who were diagnosed with ADHD. However, gender differences among groups existed as majority of subjects were males were more than females. Future researches need to focus on these

changes and examine which activities and dietary pattern is most effective on both mental health and symptoms in children diagnosed with ADHD. It would be interesting to examine this relationship further by conducting a large cross-sectional research that would only include students with ADHD that have comorbidity of anxiety, depression and dyslexia for example.

More research findings on these issues could have great impact on life and future of young students in the school system. The mechanisms and effects of food need to be investigated—example, at a functional and structural brain level and in relation to genetic factors that increase the susceptibility to ADHD. Also, the challenge procedure, which is done to identify the incriminated foods in clinical responders, should be made as easy as possible to follow, to increase the feasibility of the diet. Furthermore, the long-term effects of foods should be investigated; children might outgrow the sensitivity to the incriminating foods when they are avoided for a long period of time. Such research findings will be helpful for teachers and others working with young children and adolescents. It would gain information that could help them to improve instructional matters and health programs as well as help them to be closer to meet student's individual needs.

The findings of the present study can recommend that garden based dietary intervention should be considered in all children with ADHD, provided parents are willing to follow a diagnostic restricted elimination diet for a 5-week period with an expert supervision. Children who react favorably to this diet should be diagnosed with food-induced ADHD and should enter a challenge procedure, to define which foods each child reacts to, and to increase the feasibility and to minimize the burden of the diet. In children who do not show behavioral improvements after following the diet, standard treatments such as drugs, behavioral treatments, or both should be considered.

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CHAPTER: 7

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GARDENING BASED DIET THERAPY FOR SCHOOL GOING STUDENTS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

by

MALAVIKA, G.
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ABSTRACT

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ABSTRACT

Garden based diet therapy for school going students with Attention Deficit Hyperactivity Disorder.

Attention Deficit Hyperactivity disorder is also a neurobehavioral disorder and is alarmingly increasing in the society. Recent studies on nutrition and ADHD recommends that elimination of certain foods from the diet reduces symptoms of ADHD.

The research work entitled, "Garden based diet therapy for school going students with Attention Deficit Hyperactivity Disorder" was conducted during 2017-2019, with the objective to determine the impact of garden-based diet therapy on the ADHD symptomology of school going children with ADHD in a randomized control trial.

The present study was carried out with questionnaire in the form of rating scale to determine the food consumption patter, frequency and preference of the students with ADHD undergoing garden-based nutrition education. A pilot study on 20 students was conducted to find the reliability and validity of the questionnaire.

The sample of the study consisted of 103 students with ADHD symptoms from schools of Thiruvananthapuram and Kollam district which was categorized into two groups experimental (53) and control group (50). The study was conducted in three phases: 1)Pre intervention assessment, 2)Garden based nutrition intervention and 3)Post intervention assessment.

The garden-based nutrition intervention was imparted to the experimental group and the participation of the students were recorded by providing participation index score for each activity. The control group was only subjected to nutrition education intervention. The pre assessment included the anthropometric measurement, ADHD symptoms (using DSM IV), dietary recall, food frequency and food preference. The post assessment included ADHD symptoms, dietary recall, food frequency and food preference.

The items used to evaluate the food frequency and food preference are sugar(Tea, Juices, Candy, Ice-cream); maida (Parotta, Puffs, Biscuit, Bread); chocolate (Milk chocolate,

Dark chocolate, Nut chocolate,Wafer chocolate); bakery items (Cake, Jileebi, Ladoo, Chips) and fizzy drinks(Miranda, Coca-Cola, Sprite, Mountain dew).

The result of the study shows that there is a significant difference between the pre and post ADHD scores of experimental groups and no significant difference were found in the pre and post ADHD scores of control group. The food frequency of food items like sugar, maida, chocolate, bakery items and fizzy drinks of the experimental group showed a significant difference in the pre and post intervention scores. However, in the control group the food frequency in the consumption of chocolate in the pre and post intervention was found to have no significant difference. But there was significant difference found in the consumption of sugar, maida, bakery items and fizzy drinks. Food preference of the food items of experimental and control group when compared, there were significant difference in the preference of all food items in the experimental group. In the control group, significant difference was found in the food preference of maida and chocolate and there was no significant difference found in the food preference of sugar, bakery items and fizzy drinks.

The results also revealed that there is significant correlation between the participation index score of gardening with ADHD score in the experimental group. Thus, the study establishes that the ADHD symptoms were reduced in children who participated in the garden-based nutrition intervention. The study also showed that there is no significant correlation between the participation index score of nutrition education session with ADHD score in the control group. The results also depict that the ADHD scores reduced after eliminating food items like sugar, maida, chocolate, bakery items and fizzy drinks.

The results of the study depict that when children with ADHD participated in the gardening activities after receiving nutrition education. The preference and the frequency of consumption of the food that triggers ADHD symptoms have reduced. It was also seen that when compared to control group which received only nutrition education. The experimental group showed significant changes in the food frequency and food preference towards the ADHD elimination food. Hence the present study reveals that gardening along with nutrition education can reduce the ADHD symptoms.

Parent of the children of ADHD should have thorough understanding of the role of healthy diet and the elimination diet. It is also advisable that every school has a curriculum to

include gardening activities which can eventually reduce ADHD symptoms in children with ADHD.

Vanderbilt ADHD Diagnostic Teacher Rating Scale

Child's Name: **Teacher's Name:** **Teacher's Fax#**

Today's Date: **School:** **Grade:**

Directions: Each rating should be considered in the context of what is appropriate for the age of the child you are rating and should reflect that child's behavior since the beginning of the school year. Please indicate the number of weeks or months you have been able to evaluate the behaviors:

Is this evaluation based on a time when the child: ☐ was on medication ☐ not on medication ☐ not sure

Behavior:	Never	Occasionally	Often	Very Often
1. Fails to give attention to details or makes careless mistakes in schoolwork	0	1	2	3
2. Has difficulty sustaining attention to tasks or activities	0	1	2	3
3. Does not seem to listen when spoken to directly	0	1	2	3
4. Does not follow through on instructions and fails to finish schoolwork (not due to refusal or failure to understand)	0	1	2	3
5. Has difficulty organizing tasks and activities	0	1	2	3
6. Avoids, dislikes, or does not want to start tasks that require sustained mental effort	0	1	2	3
7. Loses things necessary for tasks or activities (school assignments, pencils, or books)	0	1	2	3
8. Is easily distracted by extraneous stimuli	0	1	2	3
9. Is forgetful in daily activities	0	1	2	3
10. Fidgets with hands or feet or squirms in seat	0	1	2	3
11. Leaves seat when remaining seated is expected	0	1	2	3
12. Runs about or climbs too much when remaining seated is expected	0	1	2	3
13. Has difficulty playing or engaging in leisure activities quietly	0	1	2	3
14. Is "on the go" or often acts as if "driven by a motor"	0	1	2	3
15. Talks excessively	0	1	2	3
16. Blurts out answers before questions have been completed	0	1	2	3
17. Has difficulty waiting in line	0	1	2	3
18. Interrupts or intrudes in on others (eg, butts into conversations /games)	0	1	2	3
19. Loses temper	0	1	2	3
20. Actively defies or refuses to comply with adult's requests or rules	0	1	2	3
21. Is angry or resentful	0	1	2	3
22. Is spiteful and vindictive	0	1	2	3
23. Bullies, threatens, or intimidates others	0	1	2	3
24. Initiates physical fights	0	1	2	3
25. Lies to get out of trouble or to avoid obligations (ie, "cons" others)	0	1	2	3
26. Is physically cruel to people	0	1	2	3
27. Has stolen things of nontrivial value	0	1	2	3
28. Deliberately destroys other's property	0	1	2	3
29. Is fearful, anxious, or worried	0	1	2	3
30. Is self-conscious or easily embarrassed	0	1	2	3
31. Is afraid to try new things for fear of making mistakes	0	1	2	3
32. Feels worthless or inferior	0	1	2	3
33. Blames self for problems, feels guilty	0	1	2	3
34. Feels lonely, unwanted, or unloved; complains that "no one loves him or her"	0	1	2	3
35. Is sad, unhappy, or depressed	0	1	2	3

SCHEDULE TO ASSESS INDIVIDUAL DIETARY CONSUMPTION OF THE SUBJECTS

1. **Name of the respondent:**
2. **Age:**
3. **Sex:**
4. **Class:**

Actual food intake of the respondent (24 hours dietary recall method)

Meal pattern	Menu	Raw quantity of each ingredients	Individual intake
Break fast			
Lunch			
Tea time			
Dinner			

SCHEDULE USED FOR COLLECTING DATA PERTAINING TO THE FREQUENCY OF USE OF FOODS

1. Name of the student :
2. Sex :
3. Age :

Food items	Daily	Weekly	Fortnightly	Monthly	Occasionally	Never
SUGAR						
Tea						
Juices						
Candy						
Ice cream						
MAIDA						
Parotta						
Puffs						
Biscuit						
Bread						
BAKERY ITEMS						
Jileebi						
Ladoo						
Cake						
Chips						
CHOCOLATES						
Milk chocolate						
Dark chocolate						
Nut chocolate						
Wafer chocolate						
FIZZY DRINKS						
Miranda						
Cococola						
Sprite						
Mountain dew						

SCHEDULE USED FOR COLLECTING DATA PERTAINING TO THE FOOD PREFERENCE

1. Name of the student :
2. Sex :
3. Age :

Food items	Liked very much	Liked	Just liked	Disliked	Not at all liked
SUGAR					
Tea					
Juices					
Candy					
Ice cream					
MAIDA					
Parotta					
Puffs					
Biscuit					
Bread					
BAKERY ITEMS					
Jileebi					
Ladoo					
Cake					
Chips					
CHOCOLATES					
Milk chocolate					
Dark chocolate					
Nut chocolate					
Wafer chocolate					
FIZZY DRINKS					
Miranda					
Cococola					
Sprite					
Mountain dew					

SCHEDULE TO ELICIT INFORMATION ON THE ANTHROPOMRTRIC STATUS OF THE SUBJECTS

1. Name of the student :
2. Age :
3. Sex :
4. Class :
5. Body weight (kg) :
6. Height (cm) :
7. Body mass index(BMI):

GARDEN BASED NUTRITION EDUCATION

PARTICIPATION INDEX SCORE SHEET

Name of the student:..... Age ..... Gender. F/M.

Name of the School .....

DAY 1 **DATE:.....** Topic: Introduction class using ppt

Attendance	0	1	2	3
Responded to the questions	0	1	2	3
Participated in the discussion	0	1	2	3

DAY 2 **DATE :.....** Topic : Games

I. Fruit shadows

Attendance	0	1	2	3
Responded to the questions	0	1	2	3
Participated in the discussion	0	1	2	3

II. Fruit necklace

Attendance	0	1	2	3
Responded to the questions	0	1	2	3
Participated in the discussion	0	1	2	3

DAY 3 **DATE :.....**

III. Identify the fruits and vegetables

Attendance	0	1	2	3
Responded to the questions	0	1	2	3
Participated in the discussion	0	1	2	3

IV. Fill the bowls with fresh fruits

Attendance	0	1	2	3
Responded to the questions	0	1	2	3
Participated in the discussion	0	1	2	3

DAY 4 DATE :..... Topic : Gardening

I. Soil preparation

Attendance	0	1	2	3
Responded to the questions	0	1	2	3
Participated in the discussion	0	1	2	3

II. Seed / crop selection

Attendance	0	1	2	3
Responded to the questions	0	1	2	3
Participated in the discussion	0	1	2	3

III. Sowing / planting the saplings /manuring

Attendance	0	1	2	3
Responded to the questions	0	1	2	3
Participated in the discussion	0	1	2	3

DAY 5 DATE :.....

IV. Watering

Attendance	0	1	2	3
Responded to the questions	0	1	2	3
Participated in the discussion	0	1	2	3

V. Protection

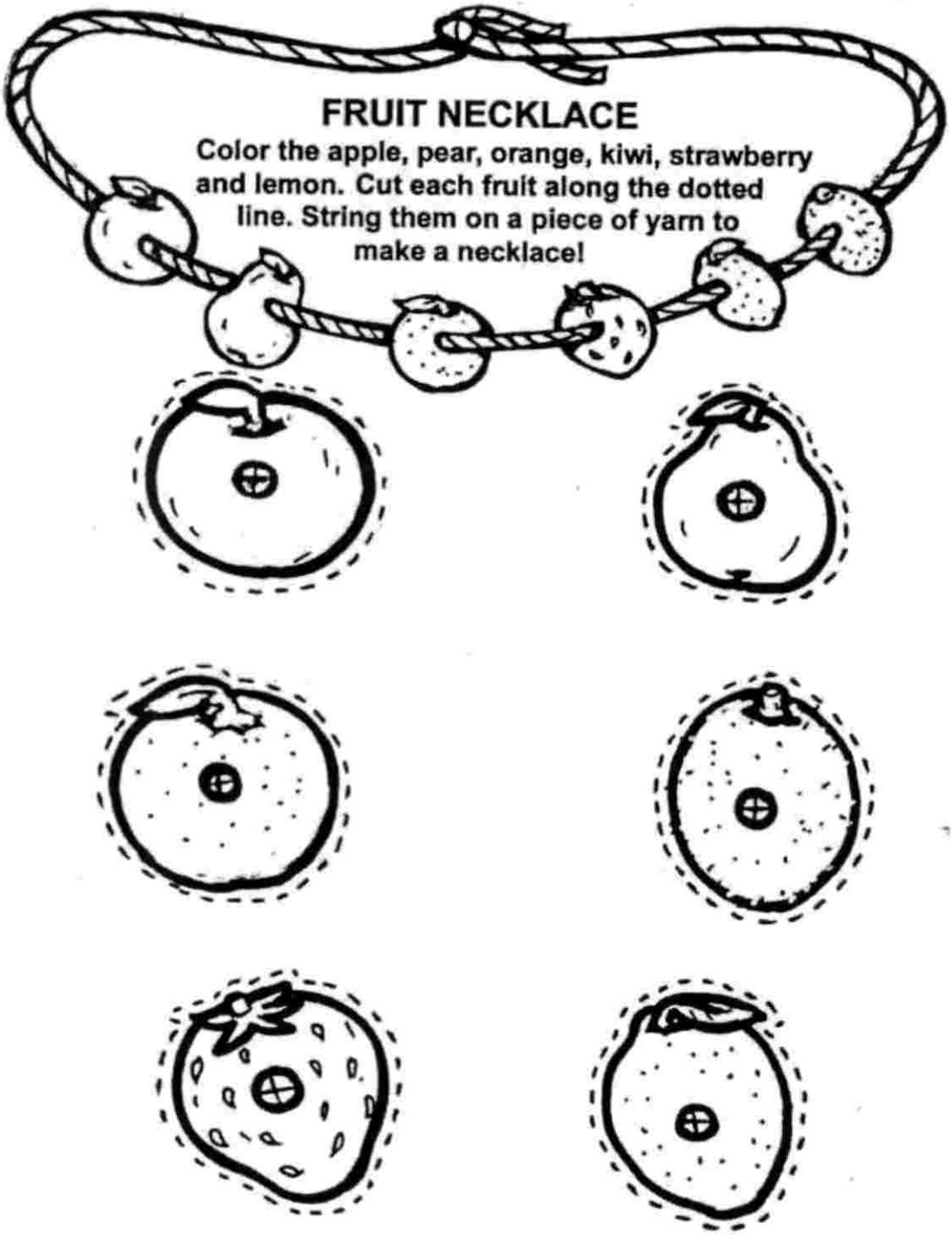
Attendance	0	1	2	3
Responded to the questions	0	1	2	3
Participated in the discussion	0	1	2	3

VI. Harvesting

Attendance	0	1	2	3
Responded to the questions	0	1	2	3
Participated in the discussion	0	1	2	3

FRUIT NECKLACE

Color the apple, pear, orange, kiwi, strawberry and lemon. Cut each fruit along the dotted line. String them on a piece of yarn to make a necklace!



Fruits and Vegetables. Eat 5 A Day. Fruits and Vegetables.
Which are fruits and which are vegetables?

Fruit Shadows

Draw a line from each fruit to the correct shadow.

ഡിപ്പാർട്ട്മെന്റ് ഓഫ് കമ്മ്യൂണിറ്റി സയൻസ്

കോളേജ് ഓഫ് അഗ്രിക്കൾച്ചർ

വെള്ളായണി

അറ്റൻഷൻ ഡെഫിസിറ്റ് ഹൈപ്പർ ആക്ടിവിറ്റി ഡിസ് ഓർഡർ ലക്ഷണങ്ങളുള്ള കുട്ടികൾക്കുള്ള ഭക്ഷണക്രമം (Diet Chart)