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THE ADHD OBSERVATIONAL STUDY CONDUCTED BY NATURALLY NURTURED INTERNATIONAL IN SINGAPORE

STUDY COMPILED BY NNI Singapore and NNA Australia and REPORT BY MARK BAKER B.ED, B.BUS

As a 30-year career classroom teacher, I have had vast experience working with students who are diagnosed with Attention Deficit Hyperactivity Disorder (ADHD).

Although this disorder is being studied much more than in prior decades, there are still many mysteries that surround this diagnosis. ADHD is often diagnosed in childhood through evaluation of notable symptoms by a child's pediatrician or psychiatrist along with anecdotal reports from those who spend significant time with the child such as parents, teachers, or other caregivers.

Throughout my 30 years in the classroom, the increase of this diagnosis in students has increased exponentially, which is putting a significant strain on dynamics and resources both in the classroom and at the home of the child.

Of course, there are therapeutic and pharmacological interventions that can be used to help those who live with ADHD symptoms, but those only go so far. Diet is a major area where modifications may have a positive impact on ADHD symptoms in children. (1) (2) (3)

Whole diet approaches have many families asking 'whether simply eating a healthy diet prepared in their own home will help their child's ADHD symptoms'.

The studies indicate that for some a simple diet is a solution for positive results for ADHD children. While other children have a stronger response through the inclusion of an "elimination diet" of key food ingredients and food with key vitamins and minerals. Yet some children have no impact on symptoms through a diet approach.

Certain dietary patterns have been associated with ADHD symptoms. Adolescents who consume a Western diet, characterized by a high intake of refined carbohydrates, sugars, sodium and saturated fats with a lower intake of omega-3 fatty acids, fibre and folate, showed a higher prevalence of ADHD. (4)

The observed relationship between ADHD and poor diet quality can be bi-directional in that individuals with ADHD may make poorer dietary choices compared with non-affected peers as a result of higher impulsivity, reward preference or body cravings to self-medicate. (5)

While eating a healthy diet is one consideration, another factor to consider is the nutrient composition of foods consumed in the 21st century compared with 50 or 100 years ago. The mineral composition of 20 fruits and vegetables in the 1940s compared with the same fruits and vegetables in the 1990s, was significantly lower (High yield crops produced with fertilizers, pesticides and heavy irrigation may lead to significant soil depletion of these nutrients). (6)

The origination of NNA regenerative restorative grown whole foods is to meet a new standard of food intervention to assist with food health in such cases as ADHD being both healthy whole foods and tested for higher nutritional content for vitamins, minerals and toxicity. The foods are tested to be free from dangerous chemicals and dangerous heavy metals.

THE OBJECTIVE

1. The NNI Observational Study was to identify if there is a positive improvement in ADHD pillar symptoms for children between 7-14 years of age given the nutritional and non-toxicity benefits of NNA foods.
2. Can the food benefits identified in scientific peer results be transferred from a laboratory to a real time kitchen and provide similar benefits for ADHD children's symptoms.

HYPOTHESIS

Is there a basis for such a hypothesis that quality clean whole nutritious foods have a positive benefit for children with ADHD which can be prepared in a home kitchen environment?

SECTION 1 - LITERATURE REVIEW

ADHD – A PRESPECTIVE ON PAST STUDIES ON FOOD, NUTRITION AND DIET RELATED RESEARCH STUDIES

THE LITERATURE STUDY

ADHD is the most prevalent child syndrome in schools accounting for 1 in 20 children (3-5% Singapore children population), (Australia between 5-16%) according to Health and Wellness Commission (2018) and accounts for 18% of all pediatric specialist visits and is a major contributor of failing education for this sector of school aged children (4-12 years).

The following is an excerpt from the Productivity Commission Submission Australia 2020 for outcomes of ADHD Children.

A substantial literature review by Sciberras et al (2013) (A) demonstrated that both boys and girls with ADHD are at risk for a range of poorer outcomes in adolescence and adulthood.

In addition to behavioural issues, substance abuse, mood and anxiety disorders, these also include poor educational, social and occupational outcomes. The most recent disturbing findings are that ADHD adults may have a shortened life by 13 years (Dr Russell Barkley 2018).

Parents of children with ADHD also have poorer outcomes over time, including increased psychological stress and poorer family functioning than parents of non-ADHD children.

Sciberras et al (2013) also noted that ADHD symptoms persist into adolescence and adulthood for approximately 50% of those diagnosed with ADHD.

Although there may be a decline in ADHD symptoms as children progress into adolescence and adulthood, the impairments associated with the disorders tend to persist.

Feedback from parents and students with ADHD, highlights the lack of understanding of ADHD by teachers and principals in schools; the lack of resources, support, programs, and special learning opportunities in many schools; limited and inconsistent funding of resources; the need for individualised approaches to students with ADHD; exam issues; and overwhelmingly, the huge stigma attached to having ADHD.

Untreated ADHD can cause lifetime impairment; however, there are effective ways of managing ADHD. Early diagnosis and early interventions are critical. The majority of parents are committed to improving the educational, social and life outcomes for their children with ADHD.

This is evidenced by ADHD now being the most common reason for pediatrician presentations in Australia, accounting for 18% of general consultations.

There are also various other medical and clinical specialists that parents can utilise, providing they have the means to do so, including numerous ADHD support groups, such as SPARK in Singapore, many of which are local. The impact of what happens at school is incredibly far-reaching and definitive for every child and even more so if they have ADHD.

Recent research by the **Murdoch Children's Research Institute (MCRI)** found that 40% of students with ADHD failed to meet NAPLAN minimum standards in at least one academic area. In year seven, 73% of students with ADHD had problems with writing and almost 25% were below the minimum standard. In year nine, 54% had difficulties and 37.5% did not reach the minimum standard.

What do Classroom Teachers Say?

ADHD teachers' summary points from discussion with 10- 30 year tenure teachers who have observed the dramatic increase in both the presentation of the symptoms, dealing with the classroom reality and the use of medication.

- ADHD students have a profound impact on classroom stability. Increasing unrest, in older students' violent behaviour, poor attendance and behaviour issues which disturbs the entire classroom.
- ADHD students often require medication which is not stabilised for the child. Due to being a syndrome this can lead to periods of extreme behaviours from anxiety, depression and mood swings to suicidal thoughts and voices in their heads.
- Teachers or School Student Services are often left to administer ADHD drugs which can be forgotten, doubled up and/or incorrect amounts administered. Neither Teachers or Student Services are skilled or trained, nor are there systems in place to manage long term medication dispensing.
- ADHD diagnosed children often require special services, teaching management plans and classroom environments to assist in keeping up with fellow classmates which resources do not allow for.

¹NAPLAN is an Australian set of four or five standardised tests depending on a child's year level. NAPLAN tests multiple areas across literacy and numeracy skills. NAPLAN is taken by students in years 3, 5, 7, and 9

Outcomes from Literature Studies related to Diet

ADHD has been conceptualised as a neurodevelopmental disorder (Thapar et al., 2017), (8) with a prevalence of 5–6% in childhood and adolescence (Willcutt, 2012) and 2–3% in adulthood (Fayyad et al., 2017).

ADHD-like symptoms description is not a novelty (Victor et al., 2018) (9), as an association between ADHD and impairment across the lifespan was found. Emotional dysregulation (Beheshti et al., 2020) (-13) 10, poor social skills (Ros and Graziano, 2018), and peer problems contribute to this burden (Strine et al., 2006). Other ADHD adverse outcomes include educational underachievement and reduced language performance (Breslau et al., 2011); Korrel et al., 2017), (11-13) unemployment, lower socioeconomic status (Biederman and Faraone, 2006), substance use disorder (Lee et al., 2011), (11-13) delinquency/criminal behavior (Mohr-Jensen et al., 2019), increased risk for accidental injuries (Adeyemo et al., 2014; Ruiz-Goikoetxea et al., 2018; Vaa, 2014), suicide (Chen et al., 2019; Septier et al., 2019) and premature death (Dalsgaard et al., 2015; Sun et al., 2019) (11-13) have been identified across 20 years of research.

The First Food, Nutrition and Diet research papers as a contributor to ADHD and as a Part of the Solution:

The first mention of diet was in response to obesity findings. Obesity is more frequently observed among adolescents with ADHD compared to their non-diagnosed peers, which could reflect an unhealthy diet. Further aspects in regard to obesity in ADHD needs to be considered. Impulsivity is one of the key elements of ADHD and strong links between impulsivity and high-calorie foods, overeating and obesity have been well established. (14)

Further, it is well-documented that drug use and abuse are substantially higher among those with ADHD compared to the general population. In this regard, some foods high in fat, sugar and salt are noted to be increasingly as addictive as some drugs. (15)

Thus, leading to excessive food consumption, which ultimately leads to obesity. The food could hence serve as a form of 'self-medication' in those with ADHD given the dopamine-release that is observed with addictions.

ADHD Studies relating Food, diet and nutrition have taken distinctive pathways including;

1. A special diet of key foods.
2. Nutrition
3. An elimination diet of key "irritators".
4. Vital vitamins and minerals for ADHD children to assist with the management of symptoms. This often includes supplements.

Testing of hypotheses have varied from observational, control group and non-control group clinical studies and testing using a medical procedure.

The NNI study was undertaken using the observations of key peers of the participant child. The study was undertaken in a home environment, not under any "control" environment, to understand if duplication of peer science reports in a laboratory can be transferred into a child's environment while still achieving the positive impacts on the ADHD symptoms as many of the following studies have demonstrated.

LITERATURE REVIEW OF FOOD STUDIES

1. SPECIAL DIETS.

Diet, nutrition, food (DNF) pathway research commences with observational studies for ADHD children with comments by teachers, parents and those close to the ADHD child.

The research base was food neophobia, food restriction and food diet types.

1.1 FOOD NEOPHOBIA

Food neophobia (FN) is a psychological trait representing a dietary pattern that causes deficiencies in several nutrients, many of which are similar to the findings in ADHD adolescents. (16)

FN is defined as the rejection and avoidance of food items that are considered unknown by the eater. This contrasts with picky eaters, who refuse to eat familiar foods.

The mechanisms underlying food rejection are still unclear, as the main factors influencing food rejection by ADHD children have not been clearly identified. FN is connected to many aspects of human eating, ranging from active chemosensory exploration (sniffing and tasting) to psychological responses associated with alertness. The olfaction constitutes an early warning system against odorant molecules from, for example toxic foods to be avoided. Thus, an important function of olfaction is its involvement in eating, ranging from food selection to appreciation and recognition for ADHD children.

Comparison to NNI findings

The NNI Introduction questionnaire, observations identified 77% of the child participants had food sensitivities, “belly aches”; poor reaction to food after digestion, texture, smell and “sight sensory” issues. According to parent discussions of NNI study participants, the children often resorted to fast food take away chicken nuggets, noodles, sugary foods, soft drinks, junk foods and especially high processed carbohydrates.

From Mark’s observation as a high school (Years 7-12) teacher in Australia, “ In general I observed many ADHD students seem to “medicate” themselves with high caffeine soft drinks, cheaper low taste - high carb chips, biscuits and general “ junk food”.

1.2 AVOIDANT/RESTRICTIVE FOOD INTAKE DISORDER (ARDIF)

Avoidant/restrictive food intake disorder (ARDIF) is a diagnostic category.

It is a disorder characterised by extreme picky eating which causes nutritional deficiencies. ARDIF and food neophobia display some of the same features with a disturbed eating experience that is associated with malnutrition and/or weight gain in children.

ARDIF patients are more likely to have a psychiatric disorder compared to those with other eating disorders – higher rates of autism spectrum disorder, depression and ADHD are reported (17). ARDIF is thus overrepresented in patients with neurodevelopmental disorders and is not yet clarified if these disorders display the same pathophysiology that causes a deviating dietary habit.

Mark commented, “many of my ADHD students were not “picky eaters” as much as avoidance eaters. Most Western Australian and Tasmanian schools where I have taught , have “healthy eating” canteens. ADHD students in many cases, would not go and purchase an apple, salad sandwich or similar, students (a strong representative number of ADHD students) would become fixated on high caffeine and high carbohydrate food requirements. Students would become anxious, obsessed, or aggressive to have a “fix” of the food. I am not in a position to hypothesize the basis, only comment on the behaviour witnessed in over 30 years as a teacher.”

What has been observed in the research according to the Raine Study “ are food preferences, food neophobia and chemo sensation among adolescents with ADHD” is highly common (16) .

Unfortunately, only a small number of studies have investigated the combination of olfactory and gustatory function in adolescents diagnosed with ADHD and their dietary habits.

Agreeing with the Raine study and Danish study: (et el 13) the following was highlighted:

1. Adolescents with ADHD have unhealthier food preferences compared to their peers without ADHD based on the 64-food item preference scale;
2. that higher levels of food neophobia are present among adolescents with ADHD; and
3. that unhealthy food preferences are associated with impaired olfactory and gustatory function.

Additionally, summary of the ADRIF findings include:

1. Teens with ADHD seem to have olfaction issues (smelling which may impact their desire to eat)
2. ADHD children impaired tasting sensory behavior most importantly taste, smell and texture.
3. ADHD children exhibited very one-sided dietary patterns that were heavy on starch and snack products and conversely low on vegetables and fruit.

1.3 LONG-TERM EFFECTS OF A OLIGOANTIGENIC DIET RESTRICTIVE DIET SIMILAR TO FEWER FOODS DIET (FFD) IN CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD) ON CORE SYMPTOMATOLOGY

(It is important to note that of all the study responses, the FFD was the most utilised in studies of food, diet and nutrition on ADHD children and provided the strongest correlation for positive results.)

The study demonstrated a significant reduction of ADHD symptoms directly after a four-week OD treatment. The study was able to replicate the positive effects of such dietary interventions described in previous studies (34-37). The Olidiet includes: restricting sugars, dairy, food colours, additives and chocolate.

Though the study was not blinded, the observed responder rate of about 64% after four weeks of diet was similar to the results of Egger [28] and Pelsser [29], who also observed responder rates of about 60%; Boris and Mandel (39) reported a 73% response rate.

The FF Diet on Mental Health for ADHD children

CBCL/4-18, the leading screening questionnaire to score a child's mental health gave a broad overview of the various psychological symptoms of the participants.

Behavioral and emotional problems of the child were obtained as well. Parents reported a significant recovery in children's mental and physical health as well as in social interactions after four weeks of a OD diet. The strongest effects could be noted in attention problems at the end of the diet. These effects were also present at follow-up.

After approximately 3.5 years, parents still reported significant improvements in children's attention symptoms.

Physical Complaints Decrease after Following a Few-Foods Diet (FFD) in Children with ADHD (38)

The study concluded attention-Deficit Hyperactivity Disorder (ADHD) symptoms may significantly decrease after following a few-foods diet (FFD).

The results of a small randomised controlled trial (RCT) showed that co-occurring physical complaints in children with ADHD decreased as well.

² the action or capacity of smelling; the sense of smell

To further investigate the effect of an FFD on physical complaints, The study analysed unpublished data from previously published studies (i.e., ‘Impact of Nutrition on Children with ADHD’ [INCA], an RCT, and ‘Biomarker Research in ADHD: the Impact of Nutrition’ [BRAIN], an open-label trial). In both trials, the association between an FFD, ADHD, and 21 individual physical complaints was assessed.

Children either followed a 5-week FFD (INCA FFD group and BRAIN participants) or received healthy food advice (INCA control group). The ADHD rating scale and a physical complaint questionnaire were filled in at the start and end of the trials. (12 complaints included abdominal pain, unusual thirst, unusual perspiration (night or daytime), often warm, eczema, blotches in the face, red ears, often tired, diarrhea, flatulence, problems sleeping in and problems sleeping on; one complaint).

The INCA results showed, 10 of 21 complaints, a clinically relevant reduction in the FFD group compared to the control group. The association between the FFD and the decrease in thermoregulation problems and gastrointestinal problems are particularly notable.

The open-label BRAIN results confirmed the outcomes of the FFD group. The results point towards an association between the FFD and a decrease in thermoregulation problems, gastrointestinal complaints, eczema, and sleep problems.

2.0 NUTRITION

Progress in Neuropsychopharmacology & Biological Psychiatry report (Feb 2022 (18) was the first of the correlated review of studies on food, nutrition and ADHD.

The study aims were to review the literature on diet and ADHD, summarize the main findings, and provide future directions regarding research and clinical impacts of nutrition on ADHD.

The team performed literature search in February 2022, including words and related terms such as “diet”, “nutrition”, “nutrients deficiency”, “Western diet”, “junk-food”, “few-foods diet”, “elimination diet”, “gluten-free”, “Mediterranean diet”, “ketogenic diet”, “DASH”, “unhealthy food”, “healthy diet” in association with “ADHD” and related terms.

According to the studies research team, “the field is very new in terms of studies available and frankly poorly studied”. The systematic investigation of the effects of nutritional factors in the expression of ADHD symptoms started with the observations of the pediatric allergist Benjamin Feingold in the 1970s (Feingold, 1975).

He observed that commonly used food additives such as salicylates, artificial colors, and artificial flavors can cause hyperactivity symptoms in children (Pelsser et al., 2017) (19).

These observations led to the investigation of the relationship between diet and ADHD. The main points the literature review of intersection found in the currently available literature are described below:

2.1. THERE IS AN ASSOCIATION BETWEEN UNHEALTHY DIET AND ADHD SYMPTOMS IN CHILDREN

one meta-analysis (Shareghfarid et al., 2020) (20) assessed the impact of three different patterns of nutrition on ADHD symptoms: Western Diet, Junk-Food Diet, and Healthy Diet.

The study comprised 4886 individuals between 6 and 14 years of age. The authors found that a “healthy” diet is protective in relation to ADHD, whereas the Western Diet and “junk food” dietary patterns increased odds of ADHD symptoms.

Overall, inattention and hyperactivity dimensions were consistently associated with the consumption of an unhealthy diet pattern, and sensitivity analysis showed that the findings were stable across age, sex, and socioeconomic status.

The literary study noted, considering the dysfunction in the dopaminergic system in persons with ADHD, consuming drinks rich in caffeine and sugar might be an attempt to self-medicate rather than cause the behaviour problems observed.

Wang et al. (2019) (21) also described that children with ADHD had a higher consumption of sugars and high-fat foods and less intake of vegetables, fruits, and protein-rich foods when compared to controls.

An Interesting fact about “Parents and Diet for ADHD children study” (22)

The study focused on diet and physical exercises for pre-schoolers with ADHD and their mothers: An intervention study finding that was not directly related to ADHD outcomes but rather access to the correct foods.

With more than half of the mothers working and having higher education, the study reveals that the mean scores of the mothers’ knowledge about nutrition, vegetables, fruits, and drinks for ADHD management improved after the educational intervention.

This study is in line with that of Abd- Elkader (23) who concluded that most of the mothers studied had a poor level of knowledge about the nutritional needs of their ADHD children, how to prepare and access information of foods, nutrition and diet.

This correlates with the NNA study outcome which identified that parents need support with education, use of produce, cooking and working with their ADHD children on food importance.

3.0 MEDICAL TESTING TO SUBSTANTIATE FINDINGS – MOVING BEYOND OBSERVATION

The use of more sophisticated tests beyond observation has been a growing science for food, diet and ADHD relationship.

3.1 USING BRAIN AND BIOMARKER TESTS TO DEMONSTRATE THE IMPACT OF THE FOODS ON YOUNG ADHD CHILDRENS’ BRAINS.

In 2018 the following was concluded by the biomarker study between brain function and ADHD children with and without FFD.

In the secondary explorative whole-brain analyses, the decrease in ADHD symptoms after following an FFD was significantly correlated with an increase in inhibition-related activation of the precuneus during a stop-signal task, pointing at an underlying neurocognitive mechanism. (40)

Other study results included randomised controlled trials (RCTs)^{26–29} 31–34 applying an FFD (fewer foods diet) in children with ADHD and have shown positive effect results and according to a meta-analysis by Nigg (25), 33% of children with ADHD benefited from dietary intervention.

In the most recent RCT, 64% of a selected subgroup of young children with ADHD responded favourably to the FFD.

⁴The dopaminergic system plays important roles in neuromodulation, such as motor control, motivation, reward, cognitive function, maternal, and reproductive behaviors

⁵The precuneus is a brain region involved in a variety of complex functions,⁶⁰ which include recollection and memory, integration of information (gestalt) relating to perception of the environment, cue reactivity, mental imagery strategies, episodic memory retrieval, and affective responses to pain.

3.2 HEAVY METALS AND ADHD: EXPOSURES TO ENVIRONMENTAL TOXICANTS AND ATTENTION DEFICIT HYPERACTIVITY DISORDER IN U.S. CHILDREN

It was found a significant lead dose-response relationship of higher blood lead levels and ADHD children. Compared with the lowest quintile of blood lead levels, children with blood lead levels > 2.0 pg/dL were at a 4.1-fold increased risk of ADHD.

The analysis of children with blood lead levels >5 pg/dL, the association between increased blood lead levels and ADHD remained. These results are consistent with previous reports that have found significant associations between blood or dentin lead levels and behavior problem. Many heavy metals are ingested through the foods that the ADHD child has been exposed to. (26) (27).

The growing body of work on impacts of toxicity in foods and ADHD provided a strong purpose to provide foods to the market that lacked these elements in the production.

3.3 USING TECHNOLOGY TO IDENTIFY RELATIONSHIPS BETWEEN NUTRITION AND ADHD SYMPTOMS

The results from the study “Effects of essential fatty acids in iron deficient and sleep-disturbed attention deficit hyperactivity disorder (ADHD) children (28)

Demonstrates that administration of the Iron/FA ratio mixture for 10 weeks to sleep-deprived ADHD children significantly improved their quality of life. The most impressive improvement was in the quality of their sleep.

Children reported a marked improvement in their ability to concentrate and that they felt less fatigued.

In addition, their mood and ability to cooperate with other people improved.

Such improvements were not observed in the control group or the placebo group.

This study shows that sleep-deprived ADHD children also suffer from iron deficiency and that an FA treatment corrected the iron level in their blood.

The study also noted diet differences in children with and without ADHD.

Over 75% eat junk food at night. In a cafeteria study (unpublished study), the sleep-deprived children consumed 20% carbohydrates, 5% proteins and 75% lipids.

Non-sleep deprived children consumed 60% carbohydrates, 20% proteins and 20% lipids. (food with lipids are protein- beef, lamb and chicken, olives and avocados).

Previous reviews in this area established that healthy dietary pattern may improve mental health.

This dietary pattern consists of vegetables, fruits, sea food, and PUFAs, high in magnesium, zinc, B1, iron and phytochemicals.

Another comprehensive review revealed that ADHD children had lower serum, red blood cell hemoglobin, and zinc in hair, urine, and nails compared with non-ADHD children. (29)

Magnesium and calcium affect synaptic nerve cell signaling and cerebral blood flow may have impact on proper brain function. (30)

In addition, it was found that magnesium of erythrocytes (ERC-Mg) decreased in excitable children (31). Healthy dietary patterns highly loaded with fish as a source of long chain LC-PUFAs are associated with normal brain function and nervous system development.

A previous study showed less concentration of this essential fatty acid in children with ADHD (et el 28).

NOTE: THERE IS NO CONCLUSIVE EVIDENCE PROVING THAT A MEGADOSE OF OFF THE SHELF VITAMIN SUPPLEMENTATION CAN AMELIORATE ADHD SYMPTOMS.

Recent dietary pattern interventions concluded that priori oriented dietary pattern such as “Mediterranean diet” and FFD food intake with high amounts of vegetables, fruits, unrefined cereals, legumes, protein and fish (which is low in western and junk foods) can improve mental health. (32)

Therefore, it is suggested that dietary patterns with modification (eliminations of some food items) can be a more comprehensive and safe approach for nutrition intake for ADHD children than supplementation of individual Vitamins and minerals.

In the study, “significantly lower serum and hair magnesium levels in children with ADHD than a non-ADHD Group : A Systematic Review and Meta-Analysis. (33)

The results of the meta-analysis found that peripheral blood magnesium levels, in either plasma, serum, or whole blood, in children diagnosed with ADHD were significantly lower than those in a control group.

The subgroup meta-analysis focusing on definite diagnostic criteria suggested that the peripheral serum magnesium levels in ADHD children diagnosed according to DSM-IV were significantly lower than those in a control group.

It was also noted that magnesium levels in the hair of children diagnosed with ADHD were significantly lower than those in controls groups.

4.0 REVIEW OF ALL STUDIES (H2)

Diet and ADHD, Reviewing the Evidence: A Systematic Review of Meta-Analyses of Double-Blind Placebo-Controlled Trials Evaluating the Efficacy of Diet Interventions on the Behavior of Children with ADHD (39)

Empirically derived dietary patterns and food groups intake in relation with Attention Deficit Hyperactivity Disorder (ADHD): A systematic review and meta-analysis (39) provided a comprehensive review of the current peer review studies with regards Food, diet and nutrition for ADHD children. It should be noted that of the 1200 studies published each year less than 3% include foods. However, this has been changing since Dr Russell Barkely commenced publishing in 2018. (see his youtube and podcast).

Conclusions of the study (39): “Healthy” dietary pattern highly loaded with vegetables, fruits, legumes, and fish has decreased the odds of ADHD up to 37%.

In addition, adherence to “junk food” pattern containing sweetened beverages and desserts as well as “Western” dietary pattern including red meat, refined grains, processed meats, and hydrogenated fat increased it.

To the best of the study’s authors knowledge, this study is the first systematic review and meta-analysis exploring the association between dietary patterns and ADHD. The results showed that more adherence to the “Western” dietary pattern was related to increased risk of ADHD by 1.92 times. Western dietary patterns contain high amounts of confectionery, grain red meat, refined grains, processed meats, potatoes (fried crisps), soft drinks, as well as animal and hydrogenated fats.

Similar to the study’s findings, research on the relation between dietary pattern and mental disorder proved that Western dietary patterns significantly increased anxiety depression, learning and memory function odds as discussed previously in this paper.

In a systematic review, unhealthy dietary patterns for ADHD children were also related to poor mental health in the children and adolescents. In addition, another systematic review reported that high consumption of processed food was associated with increased possibility of depression.

The available evidence suggests that Western diets with high amounts of fat and sugar can affect brain derived neurotrophic factor proteins that are important in brain development [51]. Western dietary patterns have also shown impaired gluco-regulation and structural integrity of the blood brain barrier.

In addition, they can reduce levels of neurotrophins and increase neuroinflammation. Pooled analysis on children who consumed junk foods more frequently revealed that they were 1.83 times more likely to develop ADHD. “Junk food” dietary pattern that is popular among children consists of chocolate, biscuits, chocolate bars, cakes/buns, pizza, sweets, crisps, cola, and other fizzy drinks.

The analysis showed that this dietary pattern strongly increased the odds of ADHD.

This pattern is low in vitamins and minerals, but it has high amounts of artificial food colors and sugar [30]. Confining the results of this study, a systematic review and meta-analysis suggested that 8% of symptoms of ADHD children were related to food colours. “Junk food” dietary patterns are characterised with high glycemic index components. In this regard, higher glycemic index foods were related to poorer memory performance in non-diabetic children.

In contrast, sweetened beverages, desserts, salt and processed meat consumption exacerbated symptoms in children.

Healthy dietary pattern was also associated with decreased ADHD chance in our meta-analysis.

⁶ Diagnostic tool for Mental Health

SECTION 2 – PRIMARY DATA NNI/NNA STUDY

5.0 THE PRIMARY DATA – NON CLINICAL OBSERVATIONAL STUDY BY NNA

OBSERVATIONAL OPINION FOR A HEALTH AND NUTRITIONAL WHOLE FOOD STUDY IN A REAL WORLD ENVIRONMENT: a 10-week randomized non controlled study to observe nutrition and behaviours of ADHD children 7-14 years using NNA Regenerative foods, LAAVA recording scan technology and family observation reporting.

The key difference of the NNA study to those noted in section 1, is the NNI/NNA study has been taken out of the laboratory and into the kitchens of the family. This is to verify if the results of the studies in the literature review in Section 1 can be duplicated in the real world. If so, what is required to ensure the results can be duplicated in the real world?

ADHD is a syndrome that is diagnosed primarily through qualitative techniques of observation, written questionnaires and reporting. There are no recognised blood tests, MRI's or any other medical techniques that are used to diagnose ADHD. Even though such tests have been used in clinical studies, the tests are not used in traditional diagnostic practices for ADHD children.

Naturally Nurtured is the first category of foods that test all foods to ensure no dangerous chemicals, dangerous pesticides and nutrition levels of 33 minerals and key vitamins of A,B, C, to ensure the best health outcome for all consumers of their foods.

The observation of whole foods using technology is aimed to evaluate the effectiveness of tailored dietary feedback and weekly reporting to track the impact of the foods (specifically those high in Zinc, Magnesium, potassium, B12, Copper and Iron). The observational study is centred on the behavioural outcomes of the group consuming fruit, vegetables and protein removing junk foods (processed sugars, additives, colours and sweeteners) from their diets. A secondary consideration is the adaptation of the food strategy into a real-world environment.

6.1 THE PARTICIPANTS

Aged 7–14 years with no “high level medical” comorbidity and diagnosed with ADD, ADHD. However, dyspraxia, dyslexia and obesity were not considered high level medical co morbidities.

Children with apraxia, autism spectrum or other high level medical morbidities were not included given the complexity for the result and conclusions.

5.2 METHOD:

Twelve (12) families were randomly chosen from the Spark Group Singapore of members on a volunteer basis to partake in the study.

Over 10 weeks, the families were delivered a range of regenerative restorative foods (fruit, vegetable and meats) to prepare for the participant child during the week and record results weekly using the questionnaire in appendix 1. The box of foods was a close fit for the FFD and DASH diets. However, they were solely whole raw foods which required preparation and cooking. Each box contained a minimum of 6 vegetables and 4 fruits and on some weeks, protein.

The emphasis of the boxes was to provide a boost in key vitamins and minerals that ADHD children are naturally low in absorption as discussed in Section 1(3.3).

These include Magnesium, Potassium, B12, Copper, Zinc and Iron.

LAAVA ID technology was located on each box of food provided to ADHD families in the chosen group. Parents provided the observational results weekly via the LAAVA ID technology scan to protect privacy. Once the results were finalised all questionnaire feedback was destroyed as per the parameters of participation.

A “whats app group” was formed to enable direct response to any questions between NNA and the families.

A presentation of the study requirements was performed for all families, a consent letter sent to all to sign, understanding the requirements and ensuring privacy.

A base line of behaviour was developed prior to a child commencing with the foods (we reject the word diet but rather we use natural eating).

The base line was established by the parents upon a set of observation questions at the start of the observational trial.

Each week parents were asked to rate an improvement or non-improvement on a scale from 1-10. The rating scale provided an improvement being 1=10% and 10= 100% improvement.

If a child moved up the likert scale from the base number provided at the beginning it was an improvement and down was regression.

This was recorded on the LAAVAID Technology questionnaire, downloaded to NNA for Review and Analysis.

5.3 COMMENCING

Parents found the requirements cumbersome in their busy routine and also due to holidays.

The age group was 7 -12 years and 70/50 % boys to girls. Boys and girls were included and the age group chosen to enable clear communication with parents of the changes experienced as younger children would be difficult and older children much harder to limit food intake.

ADHD diagnosed 20% were not on medication and 80% on ADHD medication.

Those with Autism Spectrum and delayed speech were not included as these are another form of neuropsychiatric conditions and were not part of most (98%) of secondary and literature studies which this study is based noted in Section 1.

Interestingly, Dyspraxia had been diagnosed in 59% of participants in the study

⁷ The Society for the Promotion of Attention-Deficit Hyperactivity Disorder Research & Knowledge (Spark) is a Singapore independent, voluntary and non-profit organisation set up in 2000.

⁸ LAVA ID Australian technology company that has created the patented Laava Smart Fingerprint[®],

5.4 BASE PROFILE FOR THE 10 WEEK STUDY

Prior to commencement, parents were asked to complete a survey questionnaire to formulate base result for each child from which improvement and regression could be evaluated.

From the base data the key concerns for the group were: (not in order)

1. Food issues (allergies, “picky”, texture, smell, colour)
2. Hyperactivity
3. Inattentiveness
4. Sleep deprivation
5. Weight
6. Mental issues (social , friendship and depression)

For over 80% of respondents, the children demonstrated issues with a minimum of 4 of the above identified symptoms.

Each child varied in the intensity rating score of each symptom and therefore the use of a Likert scale was the most appropriate to analyse the weekly impact changes per symptom.

Study Elements:

- A. Each child in the study was provided with a box of NNA foods that “fit” the study requirements.
- B. Each family was asked to record the results observed for their child each week based on any changes against the questionnaire provided each week. (see appendix 1)
- C. It should be noted the children were asked to eliminate artificial colours, flavours and artificial sweeteners (see appendix 2 for list) as well as processed sugars from their diet. This is in line with the FFD studies.
- D. Is it hard? - Yes. Therefore, we asked to commence eliminating or minimising. There was a blank section for answering if the child consumes soda’s, chips, trans fats (very common in take away styled foods).
- E. It was encouraged that each parent noted if they observed positive or negative change in behaviours or impact from the food. This was undertaken by numbering each week the questionnaire response

The Study commenced on 22 October 2022 and concluded on 23 December 2022.

5.5 NNA RESULTS SUMMARY

The NNI whole foods diet had a positives impact for this small observation group.

The study focused on the pillar impact areas of:

1. Inattention
2. Hyperactivity
3. Attention
4. Mental Health/Emotion
5. Food tolerance and sensory process

The top 3 key areas for improvement overall were hyperactivity, inattentiveness, and food irritation issues. The improvement factor ranged from 43% - 68% which was experienced by the majority (7/9 participants).

However, overall it should be noted that there were improvements in at least 4 pillar areas for the majority of participants.

The highlight of the study demonstrated the positive impact that quality whole foods have on key aspects of ADHD symptoms. As noted by the many studies in Section One of this report.

This study had a 10 week period for the older children 7-12 years to demonstrate change.

Generally, in peer studies, the time frame is 2 weeks to 3 months with 6 month follow up as the maximum.

The 10 week study was the average timeframe for the peer studies and so was chosen to ensure “time” was not a factor and equated to Peer studies in the results.

The study correlated with the results of the other studies noted in Section 1 of this report.

Whole foods, without processing and refining, (western diets), has a strong role to play to improve key conditions of food intolerance, mental health balance, sleep and hyperactive behaviour and concentration for many with ADHD.

The Childrens’ Response to the food - comments:

In general, the children preferred the food to the fruits and vegetables they are used to consuming.

Taste was a clear winner with even the cauliflower winning praise for tasting like “spring water rather than dirty water”.

Food irritations was a high positive relationship with responses including “did not have stomach aches”, “less tiredness” and mental “cloudiness”. “The food tasted like spring water”.

Mothers commented ...“preferred the taste so would eat the food”.

A Further Consideration:

Reviewing the peer studies and the more favourable results from the NNA study provided “food for thought”.

Why, in all studies do the areas of hyperactivity, inattentiveness, sleep and food tolerance seem to have the most benefits from a diet, food nutrition input? Is there any scientific reasoning for these benefits?

The Importance of Key Nutrition noted to be deficient in ADHD Children.:

Under the headings of Nutrition and Technology Diagnosis, in Section 1 of this report, it was found that the majority of ADHD children are low on key elements of B12, Zinc, Iron, Magnesium, Potassium, Copper and fatty acids compared to non-ADHD children.

The Consideration...

Reviewing key factors according to the studies in Section 1:

Zinc impacts: senses of smell, taste, Thyroid (source of emotion).

Magnesium is overall health, digestive system function and energy levels.

Copper is required by the body to absorb Iron. If low, it will restrict the absorption of iron. Additionally, it corrects the messages between heart and brain for every day "Normal" Functioning".

Iron: Brain function, energy and sleep. Sleep is continually being noted in peer studies with improvements in sleep correlating to improvements in many of the other pillars.

B12: Mood Health, depression , memory and concentration,

Potassium maintains sugar levels (minimizes the need to self-medicate) and Brain function.

Additionally, the incorporation of fibre in the fruits, vegetables and proteins tended to "fill" the child thus decreasing cravings and potentially obesity.

It could be Hypothesised that the nutrition ADHD children are low in naturally, are the key body functions that most impact them on a daily basis.

The small NNI group of ADHD responses also reinforced this potential correlation between an improvement in the absorption of vitamins and minerals through the absorption of foods which are unaffected by reported and alleged negative impacts of dangerous pesticides, lead – heavy metals and dangerous chemicals.

5.5 SUMMARY OF QUANTITATIVE RESULTS:

The peer reviewed studies in Section 1 noted between 43% to 73% improvement overall in all children studied for the pillar impacts,

NNA average result was between 38%-68% for all key participant on average

In order of results:

ITEM	NNA RESULTS OF IMPROVEMENT	CONTROL STUDIES FROM LITERATURE REVIEW
Food Irritation/texture and smells	68%	71%
Hyperactivity	51%	68%
Improved sleep	49%	66%
Inattentiveness	48%	51%
Concentration	43%	55%
Mental health	38%	41%

5.6 THE IMPORTANCE OF EDUCATION, ASSISTANCE AND SUPPORT FOR THE FAMILY

As indicated in a previous study noted in Section 1 (22), the raw food box was difficult for up to 70% of the parents to manage consistently to ensure foods for their children would be consistently eaten and the time consideration required for preparation. The study lost 2 families due to the time considerations required and holidays.

The parents' comments on lifestyle included:

- Preferred food choices for the children to be more prepared and easier to manage.
- Lack of time and expertise in preparation of raw foods into a continual "tasty" selection.
- Created limitations for long-term use of such food choices.

The children preferred the "clean food" taste of the NNA regenerative foods, and had a strong (67% 7/10 of respondents) positive response to the foods and willing to taste and eat items not usually consumed. There was 68% texture and food intolerance improvements.

However, in such a strong food culture as Singapore, to maintain the variety and tasting foods the children were accustomed too, provided continual challenges for the parents.

The sharing of the need for food preparation assistance was somewhat satisfied through a whatsapp chat where the more food capable parents discussed photos, prep hints and cooking tips to the other parents.

6.0 CONCLUSION AND NNI/NNA SUPPORT

It can be concluded that positive results that have been achieved under laboratory conditions can be achieved in a home environment, with some limitations being preparation of food, surety of food quality to the needs of an ADHD child, improved ease of food access and minimising preparation time.

Education and support to children is required to help them make better choices and remove key elements (as in Appendix 2) from their diet.

Assistance with the food menu to ensure the child is consuming the highlighted minerals and vitamins (see nutritional outcomes in section 1-(2.0 and 3.3) with overall nutrition that the ADHD child is known to be limiting or unable to absorb.

It can also be concluded of the importance for optimum improvement in ADHD Pillar symptoms is to build up the nutritional deficiencies that ADHD children experience.

As a minimum, the balance is critical for the foods to be strong in the key minerals and vitamins noted in the scientific reports. Also, the natural fibre has a strong role in the overall benefits to an ADHD child.

The reports in Section One highlighted that just taking shelf supplements are not sufficient due to the natural needs for the various minerals and vitamins in foods to work together for optimum absorptions.

It is critical from the results, that further research into diet, nutrition, foods and ADHD symptoms is both successful and important for the overall health and improvement to the symptoms of ADHD.

However, it does not stop at food consumption, it also includes training, education and support for the parents in delivering the food to the child and education to the child on the importance of the ADHD food program. Eliminating the "western diet" and the food processing industry additives, colours, glutens, fillers, agriculture pesticides, heavy metals and practices that deplete nutrition from the foods.

Ensuring foods are clean and nutritious, especially in the key vitamins and minerals will have an improvement in the pillar areas for the ADHD study naturally.

The NNA study also proves that food, diet and nutrition are critical to assist with the Pillar symptoms and can be delivered in a home environment.

7.0 LIMITATION

The study group understood this was not a medical control group from which medical supported peer reviewed studies can be formulated. The children were not reviewed by medical staff or medical tests undertaken to reinforce results.

The sample size was very small and therefore, a larger study is recommended of at least 1000 participants to be relevant scientifically.

The NNA study was seeking to determine if an everyday eating food program (not diet) can be implemented in a home using “clean nutritious food” enabling the positive findings of the correlated secondary data studies, on having a positive impact on the symptoms of ADHD.

It is important for future studies to understand the role of accessing the foods and support for the family is needed.

The limitation of control was also a factor in this study. As this was a real-world study, the ability to control the intake eating of “avoidance” foods was not possible, however this should be considered as a control exercise in future studies.

FURTHER STUDIES

Further studies should review the impact on the absorption of the key minerals and vitamins of magnesium, Iron, Potassium, B1, Zinc, Copper and fibre from clean whole foods rather than supplements as a potential tool for parents with ADHD children.

The objective should be to identify the digestion process and body brain use behind whole food nutrition and ADHD children impact.

Food production and foods available in the market to be focused upon for strong clean nutrition for children supporting brain, immune and pancreas function.

With regards to the skills transfer from laboratory to home kitchen, foods should be prepared using the “clean foods” into easy cook meal formation. The foods to be supported by education, food preparation help and tips for parents involved in home food preparation.

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APPENDIX 1 QUESTIONNAIRE

APPENDIX 2 FOODS FOR REMOVAL