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A Review on Nutritional and Dietary Intervention for Autism Spectrum Disorder

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

In this review we will be looking at nutritional intervention that can be used to achieve better results in management and treatment of autism spectrum disorder. Eating disorders are widespread in children with autism and autism spectrum disorders (ASDs). Their penchant for high-energy, low-nutrient foods can change their metabolism, creating an accumulation of reactive radicals and mental and physical deterioration. Probiotics, which are live microorganisms that provide a health benefit to the host when given in sufficient amounts, are gaining popularity as a potential treatment option for ASD. Studies shows that using of special and alternative nutritional diets can achieve better results for children with autism however some of these studies shows that the true effectiveness of such approaches is minimal if not lacking at all. It is recommended that there are many factors that play role in outcomes of theses treatment therefor more research is must in order to draw clear conclusion weather or not using of alternative diet is effective enough and if so, what's the best guidelines for it.

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1. INTRODUCTION

Autism spectrum disorder (ASD) is a neurodevelopmental illness characterised by restricted and repetitive activities and interests, as well as impaired social interaction and communication [1].

Eating disorders are widespread in children with autism and autism spectrum disorders (ASDs). Their penchant for high-energy, low-nutrient foods can change their metabolism, creating an accumulation of reactive radicals and mental and physical deterioration. Although dieting and weight loss are already widespread in the general community, it has become difficult to raise awareness about diet, nutrition, and obesity among children with special needs. Despite their best efforts, parents of such children are frequently unable to control their children's eating habits because tantrums and behavioural issues are common [2].

Because ASD has no recognised cause or cure, desperate parents are eager to attempt any treatment that helped a child with ASD, regardless of its effectiveness, safety, or adverse effects. This has been the case with restrictive dietary therapies such as gluten-free/casein-free and ketogenic diets, and probiotics have lately become the latest rage. One of the concerns about these dietary and probiotic treatments is their non-specificity: they may not be effective for all people with ASD, not all probiotic strains may have the benefits advertised indiscriminately for probiotics, and strains that provide benefits in one condition may not be probiotic in another [1].

The connection between nutrition and autism spectrum disorder (ASD), a complex developmental disorder characterized by significant delays or deviations in interaction and communication, has provided a new perspective, and showed that nutrition may play a role in the etiology of ASD as well as play an active role in treatment by alleviating symptoms. While gluten-free/casein-free and ketogenic diets have been shown to help people with ASD, and also camel milk, curcumin, probiotics, and fermentable foods have also been shown to help. On other hand it seems that Sugar, additives, pesticides, genetically modified organisms, inorganic processed meals, and difficult-to-digest starches are all known to worsen symptoms [3].

In this review we will be looking at nutritional intervention that can be used to achieve better results in management and treatment of autism spectrum disorder.

1.1 Epidemiology

ASD is a collection of neurodevelopmental disorders that impact social interactions, communication, and repetitive behaviour. ASD is thought to affect somewhere between 0.1 and 1.8 percent of the world's population. According to recent epidemiological studies, the prevalence of ASD is estimated to be 62 per 10,000 people. Current research suggests that a number of factors, including genetic, epigenetic, and environmental factors, are linked to the development of ASD. Maternal virus exposure, dietary deficits or overloads, de novo mutations during embryonic development, paternal sperm, parental obesity, parental allergies, and immune system malfunction are among these causes. ASD patients also have impaired cognitive and communication abilities [4-11].

According to studies, ED is one of the major contributors of comorbidities. When compared to the general population, children with neurodevelopmental problems such as autism and autism spectrum disorders (ASDs) are the most likely to acquire ED. According to recent studies, up to 3% of children in the United States, or one in every 68 children, may have autism and ASD. Autism and ASD children exhibit fewer social interactions, little eye contact, repetitive stereotypic sensory and motor behaviours, and little or no communication with others. Individuals with autism and ASD are also less likely to engage in any form of physical activity, leading to overweight and obesity. These kids have a reputation for being finicky eaters who love junk food: calorie-dense, carbohydrate-dense, sodium-dense, and nutritionally deficient [2].

1.2 Dietary Treatment Options

1.2.1 Probiotics

Gut bacteria have been demonstrated to be essential for digesting substrates that would otherwise provide the host with little nutrients. Microbes also produce short chain fatty acids (SFCAs), which are critical for the intestinal mucosa, immunological response, and cancer in

the gut. Gut bacteria are also a good source of vitamin K and, to a lesser extent, vitamin B. Cancer, diabetes, obesity, cardiovascular illnesses, autoimmune disorders, neurological diseases, and, most crucially for the purposes of this analysis, autism have all been linked to gut microbiota dysbiosis, or an imbalance in gut bacteria composition [4,12-27].

Probiotics, which are live microorganisms that provide a health benefit to the host when given in sufficient amounts, are gaining popularity as a potential treatment option for ASD, based on preliminary promising findings of normalizations in gut microbiota alterations, improvements in gastrointestinal symptoms, and reductions in autism symptoms and severity in individuals with ASD after probiotic administration [1,28-31].

Because probiotics aid gluten digestion, counteract gluten's detrimental effects on gut permeability, reduce gut inflammation, promote gut integrity, and relieve gastrointestinal and ASD symptoms, they can be a safer alternative to these restrictive diets. finished by speculating that some strains or combinations of probiotics may be more effective for people with ASD who have co-morbid disorders like dietary protein intolerance [1].

Numerous research support the use of probiotics in the treatment of ASD. Although probiotics show potential in treating gut dysbiosis and autistic behavior-related symptoms, standardised clinical trials may generate more robust results and outcomes. Probiotics appear to be an important dietary component and a potentially side effect free therapy that can be proposed to treat GIS and ASD symptoms by correcting dysbiosis, reducing inflammation, and reinforcing depleted immunity by re-establishing a balanced microbial composition with subsequent balanced metabolite secretion [4].

1.3 Omega-3 Supplements

PUFA insufficiency has been associated to a number of neurodevelopmental illnesses, including schizophrenia, attention deficit hyperactivity disorder (ADHD), bipolar disorder, and autism spectrum disorder (ASD). Because of their anti-inflammatory qualities and ability to maintain healthy function of the brain cell membrane and myelin sheath, PUFAs play a crucial role in brain function. Because the human body cannot generate PUFAs, several studies have hypothesised that changes in dietary habits that result in an imbalance in PUFA consumption could explain the recent rise in ASD prevalence. Omega 3 and omega 6 fatty acids are two of the most well-known polyunsaturated fatty acids (PUFAs). While the former is mostly derived from shellfish, the latter is derived from animal or vegetable oils. According to several studies, the ideal omega 6 to omega 3 dietary ratio is 1:1 to 4:1. Recent dietary changes, on the other hand, may have resulted in an increase in omega 6 fatty acid intake, which could predispose some people with genetic vulnerabilities to certain psychiatric illnesses. As a result, many clinical investigations have begun to look into the therapeutic potential of omega 3 fatty acid supplementation in the treatment of patients with psychiatric disorders [32].

Omega-3 fatty acids are one of the most often utilised complementary and alternative therapies, with 28.7% of children with ASDs using them. Omega-3 fatty acids are polyunsaturated fatty acids that come in three different forms in the human diet: ALA (alpha-linolenic acid), DHA (docosahexaenoic acid), and EPA (eicosapentaenoic acid) (eicosapentaenoic acid). Seafood contains DHA and EPA, while nut and plant oils contain ALA. EPA and DHA are produced by single-cell sea creatures that are consumed by fish, but they are not produced by fish. While the human body can make DHA and EPA from ALA, none of these three forms of fatty acids can be made “from scratch.” As a result, these compounds are commonly referred to as "essential fatty acids" and are considered important human nutrition. The body uses DHA and EPA to make a range of chemicals, including cyclooxygenases and lipoxygenases, which have a variety of physiological functions [33].

In a study for 12 weeks, ten children aged 4-7 years old with ASD were given 1 gramme of omega-3 fatty acids daily, On the Autism Treatment Evaluation Checklist, 8 of the 9 patients who finished the research showed a 33 percent improvement (ATEC). None of the patients' conditions deteriorated, and no negative effects were noted. So it concluded that omega 3 fatty acids are not only effective to use as treatment for autism, but also more importantly safe [34].

While the mechanism of action of omega-3 fatty acids for alleviating ASD symptoms is unknown, neural tissue includes significant levels of DHA, which studies suggest is crucial for the growth and functional development of the human brain. Omega-3 fatty acids have also been shown to have anti-inflammatory properties [32].

1.3.1 Gluten- and casein-free diets

The gluten-free, casein-free (GFCF) diet, which has been hailed by strong anecdotal parental claims of considerably improved and even "fixed" symptoms of ASD to the point where the kid no longer meets ASD criteria, is one popular treatment for addressing probable systemic inflammation. The GFCF diet was first recognized for usage in schizophrenia, where a suspected genetic flaw may contribute to a “leaky gut,” resulting in an excessive amount of gluten (from wheat) and casein (from dairy). This overload is thought to induce elevated peptide levels, which may have an opioid-like impact that manifests in the behavioral symptoms that are typical in ASD. Others believe that many people with ASD have undetected gastrointestinal problems and sensitivities that are caused or exacerbated by casein and gluten consumption. Due to the distraction of pain, this discomfort, or even severe pain in certain situations, may result in externalizing behaviors (e.g., tantrums, yelling, and violence) and inattention to tasks [35].

1.4 Ketogenic Diet

In neurological illnesses such as epilepsy and ASD, a KD is a dietary intervention therapy. A KD could be a helpful treatment for ASD because it can help with basic symptoms as well as comorbidities like seizures. Urinary ketones and serum beta-hydroxybutyrate must be used to assess a KD's effectiveness (BHB). A KD enhanced the essential features of ASD patients, according to some data. El-Rashidy et al. found that a KD improved autistic symptoms, as measured by improved scores on the Autism Treatment Evaluation Test (ATEC) scales and the Childhood Autism Rating Scale (CARS), particularly in terms of friendliness. A modified ketogenic gluten-free diet supplemented with medium-chain triglycerides (MCTs) improved the social affect subdomain and total autism diagnostic observation schedule, 2nd edition (ADOS-2) scores, but not the limited and repetitive behaviour scores, according to Lee et al [36-39].

1.5 Studies Results

Except for limited and repetitive activities, a modified ketogenic gluten-free diet with the inclusion of MCT supplement was observed to alleviate core autism symptoms in one study [1,40]. Another study looked at a gluten-free, casein-free, soy-free diet with the addition of special vitamin/mineral supplements like essential fatty acids and digestive enzymes, and found that 67 children and adults with ASD had improved symptoms. However, some participants reported sickness, intestinal symptoms, mild nausea, loose stools, facial rash, worsening behaviors, and increased aggressivity [1,41].

Omega-3 Studies: Supplementing omega 3 fatty acids reduced hyperactivity and stereotypy, according to a meta-analysis. In terms of overall functioning and social responsiveness, there were no significant changes between omega 3 fatty acid supplementation and placebo. Our early meta-analysis reveals that omega 3 fatty acid supplementation may help ASD patients with hyperactivity, lethargy, and stereotypy. However, because the number of research was restricted and the overall effects were minor, conclusive conclusions could not be drawn. To confirm or reject our findings, future large-scale randomised clinical trials will be required [32].

In a systemic review that looked at the outcomes and safety of using omega-3 fatty acid as dietary supplement for children with autism. Hyperactivity and stereotypy were not significantly improved in one small randomised controlled experiment. The remaining five trials were all modest, with four of them reporting increases in language and learning skills, parental observations of overall health and behaviour, a clinician-administered symptom scale, and clinical observations of anxiety. There is presently inadequate scientific data to evaluate whether omega-3 fatty acids are safe or useful for ASD due to the limitations of evidence from uncontrolled research and the presence of only one tiny randomised controlled study [33].

In another study, ASD (Autism Spectrum Disorder) was diagnosed in the research Participants, they demonstrated significant gains on all subscales of the Social Responsiveness Scale and the Child Behavior Checklist's Social and Attention Problems syndrome ratings after treatment. Changes in the fundamental symptoms of ASD were shown to be substantially linked with blood fatty acid levels. The response to the omega-3 treatment was also predicted by baseline blood fatty acid levels. Supplementing with omega-3 fatty acids was well tolerated and did not cause any major negative effects [42].

Vitamin D (VID) and omega-3 long chain polyunsaturated fatty acids were studied for their

efficacy (omega-3 LCPUFA, OM). Children with ASD in New Zealand were given either 2000 IU vitamin D3, 722 mg docosahexaenoic acid, both, or placebo on a daily basis. The Social Responsiveness Scale (SRS) and the Sensory Processing Measure were used as outcome measures (SPM). Two of the 42 outcome measure comparisons (interventions vs. placebo) showed larger improvements, while four others indicated signs toward bigger improvements. Some basic symptoms of ASD may be improved by omega-3 LCPUFA with and without vitamin D, but no clear conclusions can be drawn [43].

Comprehensive nutritional and dietary intervention trial: This is a 12-month treatment trial of a comprehensive nutritional and dietary intervention that was randomised, controlled, and single-blind. The study included 67 children and adults with autism spectrum disorder (ASD) from Arizona, ranging in age from 3 to 58 years, as well as 50 non-sibling neurotypical controls of similar age and gender. Treatment started with a particular vitamin/mineral supplement, and then essential fatty acids, Epsom salt baths, carnitine, digestive enzymes, and a healthy gluten-free, casein-free, soy-free (HGCSF) diet were introduced one by one. When compared to the non-treated group, the treatment group showed a considerable improvement in nonverbal intellectual capacity. based on a blinded clinical assessment. However, the therapy group had considerably larger improvement in autistic symptoms and developmental age than the non-treatment group, according to semi-blinded assessment. EPA, DHA, carnitine, vitamins A, B2, B5, B6, B12, folic acid, and Coenzyme Q10 were all considerably higher in the therapy group. The findings of this study imply that a complete nutritional and dietary intervention can help most people with ASD improve their nutritional status, nonverbal IQ, autism symptoms, and other symptoms. Vitamin/mineral supplements, essential fatty acids, and the HGCSF diet were the most effective, according to parents [41].

In a Systematic Review of Nutritional and Dietary Interventions: Supplements or variations of the gluten/casein-free diet and other dietary treatments were tested in 19 randomised controlled trials (RCTs), four of which had a low probability of bias. Supplementing with omega-3 fatty acids had little effect on difficult behaviours and had very minor side effects (low SOE). Different digestive enzymes had variable impact on symptom severity in two RCTs (insufficient SOE). Other supplements (methyl B12, levocarnitine) have shown some improvement in symptom severity in studies (insufficient SOE). Some parent-rated improvements in communication and challenging behaviours were observed in studies testing gluten/casein-free diets; nevertheless, the data was insufficient to draw judgments about the body of evidence (insufficient SOE). Challenge meals containing gluten or casein had no influence on behaviour or gastrointestinal symptoms in studies (insufficient SOE); camel's milk had no effect on ASD severity in one RCT (insufficient SOE). Harms came in a variety of forms [44].

2. DISCUSSION

Van Elst et al theory appears to offer a solid theoretical foundation for treating children with ASD with omega-3 supplementation. They hypothesised that dietary changes in fatty acid composition, typified by a higher omega-6/omega-3 ratio, have contributed to the rise in ASD prevalence over the last few decades. Myelination, neurogenesis, synaptogenesis, neurotransmitter turnover, brain connections, cellular differentiation and development, inflammatory reactions, cognitive performance, and behaviour may all be affected by an omega-3 deficiency, particularly in the early stages of life. All of these changes could be linked to the etiopathogenesis of ASD [45,46].

While there is currently no significant empirical support for the GFCF diet in ASD, research suggest that subgroups of people (e.g., those with established gastrointestinal disorders) may be the best responders to the diet. To improve rigour in this area of study, it is necessary to identify distinct subsets. Until solid studies supporting the use of the GFCF diet is published, physicians should proceed with care and consider a number of criteria when advising on the GFCF diet for people with ASD [35].

One of the reasons for the inconclusive evidence for the effectiveness of alternative Diet can be due to the non-personalized approach, which assumes that everyone on the spectrum has the same set of metabolic, endocrine, and physiological changes. Some studies show improvement in ASD symptoms after GF/CF diet administration, while others do not. Similarly, while KD was shown in a genetic mouse model of ASD to improve sociability and communication while decreasing self-directed repetitive behaviour, in a human trial, some participants

were unable to tolerate the KD, and only 60% of the remaining group showed improvement in ASD symptoms, which ranged from minor to significant improvement [1,47-56].

Before suggestions on the best ASD diet can be given, further prospective controlled trials with high sample sizes are required. We emphasize the importance of identifying current nutritional approaches specific to people with ASD and incorporating their effects on symptoms into the conversation, as well as making recommendations for future research aimed at identifying medical nutrition therapies for this population in order to better understand the link between ASD and nutrition [3].

3. CONCLUSION

There's no doubt that proper nutrition plays a key role in development of the nervous system of the child, therefor taking nutritional approaches for management of ASD can be helpful. Special and alternative nutritional diets can achieve better results for children with autism however some of these studies shows that the true effectiveness of such approaches is minimal if not lacking at all. We suggest that there many factors that play role in outcomes of theses treatment therefor more research is must in order to draw clear conclusion weather or not using of alternative diet is effective enough and if so, what's the best guidlines for it.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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