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## REPORT

### Autism: A Nutraceutical Approach

By Julius G. Goepf, MD



More than 60 years after it was first identified, the diagnosis and treatment of autism remain challenging. This severe disability is on the rise in the United States and other industrialized countries, with rates from two to five times what they were in 1990.<sup>1</sup> This statistic has prompted many concerned parents, physicians, and other health care providers to characterize the dramatic increase in autism as an epidemic.<sup>2,3</sup>

Despite the widespread prevalence of autism, numerous theories regarding its causes are undergoing debate within the medical community. At this time, treatment options for the condition are varied, as physicians strive to develop a standardized, results-oriented protocol.

Research has revealed that specific nutrients may play a key role in managing autism. In this innovative report, we present the latest scientific studies in which nutritional therapies have demonstrated benefits in combating this stubborn disease.

#### THE EPIDEMIC OF AUTISM

Today, more families than ever before are affected by the devastating conditions of autism and its related disorders. These puzzling conditions manifest during early childhood, producing social separation or aloofness, language delays, and impaired socialization skills.<sup>3,4</sup>

Mainstream approaches such as pharmaceuticals have failed to effectively manage autism. In the words of noted autism researcher and integrative medicine advocate Parris Kidd, PhD, "Conventional medicine has largely failed autistic individuals and their families."<sup>5</sup>

#### POSSIBLE CAUSES OF AUTISM

The failure of conventional medicine to cure autism may arise from the complexity of the condition itself. Physicians and scientists are still debating the very cause of autism, which remains a subject of much controversy.

Emerging theories suggest that there may be no single, fundamental cause of autism, but that it may instead represent a cluster of factors involving genes, inflammation, impaired gastrointestinal health, increased oxidative stress, diminished ability to neutralize toxins, autoimmune processes, and decreased mitochondrial function.<sup>3,6-10</sup> Other proposed triggers of autism include vaccine preservatives and food additives.<sup>5,11-13</sup>



#### INTEGRATIVE APPROACHES TO AUTISM

In the words of Parris Kidd, PhD, "Fortunately, because of unprecedented collaboration between activist parents, progressive physicians, researchers, and allied health workers, autism has emerged as a model of successful integrative medicine."<sup>5</sup>

Several coordinated approaches to autism are emerging from the bewildering amount of information that has accumulated in the past decade. These approaches focus on:

- Dietary modification to heal the gut and reduce exposure to external toxins
- Supplying nutritional supplements that boost the body's antioxidant and other detoxification systems
- Eliminating known contamination with highly toxic substances such as mercury, while providing nutritional support during

this biologically stressful process.

Although all treatments for autism should be administered in partnership with skilled physicians and other health care professionals, certain basic steps that are known to be effective and safe should be started as early as possible.

## DIETARY MODIFICATION: HEALING THE GUT

The majority of children with autism have impaired gastrointestinal health.<sup>3</sup> Since more than half of the immune system develops and resides in the gut, where it neutralizes infectious microbes, the consequences of poor gut health can be serious indeed. The gastrointestinal tract is also essential in digesting foods, absorbing nutrients, and preventing toxic agents from reaching the circulation—functions that may often be impaired in autistic individuals. Children with autism almost always require special attention to the status of their gut health to keep these essential processes in good working order.



Many experts now agree that the most important first step in the integrative management of autism is to heal the gut and restore its integrity, which provides natural resistance to toxins. Dietary modification should be the foundation of healing the gut. A relatively easy first step is to eliminate simple sugars such as sucrose and glucose, which can promote the growth of harmful bacteria, and to eliminate artificial sweeteners and food additives, which often contain chemicals that act as internal toxins.<sup>2,5</sup> At the same time, nutritional experts advise increasing intake of fiber, protein, and organic foods, and eliminating highly allergenic foods, which often include soy, eggs, peanuts, and tomatoes.

Many parents have also seen a multitude of noticeable benefits in their autistic children upon starting a casein- and gluten-free diet. Some experts believe that this is one of the single most effective dietary interventions that can be made, as many autistic children are unable to properly break down these dietary proteins in their bodies.<sup>5,14-16</sup> Gut healing may begin almost immediately when these proteins are eliminated, though it may take several months to see the full benefit.<sup>5</sup> Even so, removal of both gluten and casein simultaneously from the diet can be extremely challenging for children and parents, so some experts recommend a two-phase process, first removing dairy products, and later eliminating gluten.<sup>17</sup> Careful coordination with a physician and a nutritionist is essential during this period.

Also because gluten and casein are found in so many common foods, and because children with autism are often “picky eaters” to begin with,<sup>5</sup> parents should offer nutrient supplementation right at the beginning of the new diet. Many dietary supplements also have an added benefit by providing nutrients that have antioxidant, anti-inflammatory, and detoxifying properties.

## AUTISM: WHAT YOU NEED TO KNOW

- Autism and its related disorders are becoming more prevalent, yet conventional medicine has failed to uncover effective solutions.
- Autism is now thought to represent a cluster of syndromes that includes inflammation, increased oxidative stress, impaired gastrointestinal health, mitochondrial dysfunction, autoimmune processes, and impaired ability to neutralize toxins.
- Integrative approaches to autism are showing great promise. These include dietary approaches and targeted nutrients to promote gastrointestinal healing, boost antioxidant protection, enhance detoxification, and support brain cell structure.
- Chelation is a controversial therapy for childhood autism. Chelation should only be conducted by an experienced physician. Nutritional therapies may lessen the stress of chelation therapy.
- A debate rages about the potential link between autism and the measles, mumps, and rubella (MMR) vaccine.

## DIETARY SUPPLEMENTS THAT MAY BENEFIT AUTISTIC DISORDERS

Dietary supplements are helpful in autism by promoting gut health and by preventing or reducing the effects of oxidative stress and inflammatory agents. They can also support a child through the effects of a detoxification program aimed at eliminating heavy metals such as mercury, which some believe is also a risk factor for autism.

The rest of this article examines promising research involving the use of specific nutrients for managing autism. Those

responsible for caring for autistic people should always work closely with a health care provider who understands nutritional supplementation and can guide specific dosing.

## DIGESTIVE ENZYMES

Incomplete digestion of dietary proteins, especially casein or gluten, produces small “peptide” molecules that many investigators believe may contribute to some of the symptoms of autism.<sup>8,18-20</sup> In animals, these incompletely digested peptides have been reported to cross the blood-brain barrier, contributing to symptoms of social indifference.<sup>3</sup> Digestive enzymes such as trypsin, chymotrypsin, and amylase can be given orally to assist with the complete breakdown of proteins and carbohydrates, preventing the accumulation of nervous system irritants.<sup>21</sup> The plant-derived enzymes bromelain and papain are widely used for their anti-inflammatory effects, and may help correct the digestive problems that frequently accompany autism such as bloating, flatulence, abdominal cramping, and diarrhea.<sup>22</sup> Scientists are still investigating whether supporting gastrointestinal health with digestive enzyme supplements may help to improve the neurobehavioral symptoms of autism.

## PROBIOTIC REPLACEMENT

A normal, healthy population of intestinal bacteria plays a key role in the body’s detoxification system for heavy metals and other external toxins. This process is especially crucial in autistic children, who may have faulty elimination or an overload of toxic exposures. The abnormal gut environment in autistic people caused by inflammation, poor absorption, and antibiotic overuse, however, can allow the overgrowth of harmful bacteria and yeasts, which can produce toxic molecules and oxidants. High-dose probiotics are recommended to restore the natural bacterial balance<sup>23</sup> and promote integrity of the gut mucosa.<sup>24</sup> The two most commonly used probiotic bacteria are Bifidobacteria and Lactobacilli.

Scientists in the United Kingdom studied gastrointestinal bacteria in 150 children with autism. They found a very high prevalence of the harmful bacteria clostridia in children affected by autism, while clostridia were not present in the children’s non-autistic siblings. The gut microorganism clostridia can produce damaging neurotoxins that may contribute to the pathogenesis of autism. Researchers are intently studying which type of probiotic bacteria may most effectively combat clostridia in the hope of developing a novel approach to treating autism.<sup>25</sup>

## THE VACCINE CONTROVERSY

A great deal of controversy has been raised about the role of vaccines as possible causes of autism.<sup>11-13</sup> In particular, thimerosal (a mercury compound used as an antiseptic, antifungal, and preservative), which was present in the diphtheria/pertussis/tetanus (DPT) shot, has come under great scrutiny.<sup>73</sup> Animal studies have shown that certain genetic traits predispose some individuals to brain injury by thimerosal.<sup>74</sup> Other scientific studies suggest that thimerosal is not directly linked to autism.<sup>11,75</sup> In some studies, children with the condition have been found to have elevated mercury levels in body tissues,<sup>63</sup> and have improved when mercury is removed using chelation therapy.<sup>5</sup> This fact, together with vocal activism by parent groups, has led vaccine authorities to remove thimerosal from childhood vaccines,<sup>3</sup> although environmental mercury remains a significant threat.<sup>76</sup>

For a brief period, the measles, mumps, and rubella (MMR) shot, which is given at 15 months of age, was thought to have a relationship to autism, but review of all the evidence has shown no convincing effect.<sup>77</sup> The general consensus in the medical community is that while we should continue to strive hard for the safest vaccines possible, the risk of the diseases themselves far outweighs the risks posed by the vaccines. Indeed, in England, parental concern about vaccines and autism has led to a dangerous drop in the immunization rate, and health authorities fear that outbreaks of some previously nearly eliminated diseases may be on the horizon.<sup>13</sup>

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### MULTIVITAMIN-MINERAL SUPPLEMENTS

Many people with autism also demonstrate poor absorption of nutrients due to inflammation in the gut.<sup>26</sup> Poor nutrient absorption can lead to a host of health problems in growing children, including impaired growth and well-being. Individuals affected by autism also commonly suffer problems with elimination, such as diarrhea or constipation.<sup>5</sup> Diarrhea can contribute to dehydration and depletion of vitamins and minerals, while constipation impairs the body's elimination of toxic wastes.



Additionally, it is not unusual to find that those with autism have fewer beneficial bacteria in the gut to manufacture critical vitamins such as B12, K, and biotin.<sup>5,27</sup> Autism has also been linked with a common deficiency in a host of micronutrients such as vitamins A, B1, B3, B5, and biotin, selenium, zinc, magnesium, certain essential amino acids, and essential fatty acids.<sup>5,28</sup> In addition, some studies suggest that vitamins B6, B12, and folate, which are critical for healthy mood and cognitive function, are also lacking in autism.<sup>5</sup>

Research has revealed the use of multivitamin supplementation to be beneficial for children with autism.<sup>29,30</sup> A 2004 double-blind, placebo-controlled trial showed that by increasing the levels of vitamins B6 and C, children with autism showed improvements in sleep and bowel patterns.<sup>29</sup> Sleep provides crucial healing and mood stabilization for most children, and disturbed sleep can lead to a host of childhood complications. It should be noted that multivitamin-mineral supplements for autistic children should not include copper, because people with autism often have elevated copper:zinc ratios.<sup>5</sup>

### VITAMIN B6 AND MAGNESIUM

Children with autism may have low levels of the enzyme needed to convert dietary vitamin B6 into its active form, which is required to produce important nerve-signaling chemicals (neurotransmitters) that ensure healthy brain function.<sup>29</sup> For these reasons, having low levels of B6 may reduce levels of neurotransmitters that are critical for the development of language and attention and for optimizing sleep, activity, and alertness. Supplementation with vitamin B6 can increase levels of the vitamin's active form, and has been found to improve sleep, attention, and language.<sup>29,31</sup> Rigorous, placebo-controlled trials with B6 have also demonstrated statistically significant improvements in eye contact, speech, and interactions with the environment in children with autism.<sup>32</sup>

The combination of B6 with magnesium has been described as a "breakthrough autism intervention,"<sup>5</sup> with improvement in about half of the cases studied.<sup>33,34</sup> Magnesium is an essential mineral that many enzymes require in order to function properly, particularly the enzyme systems that manufacture brain neurotransmitters.<sup>5</sup> Multiple studies of vitamin B6 (75 to 800 mg per day) and magnesium (100 to 700 mg per day) have now shown that this particular nutrient combination is dramatically more effective than either nutrient alone.<sup>5,35</sup>

One of the most impressive and recent studies of this combination comes from France, where researchers treated 33 children aged 1-10 years with autism, using a daily supplement containing B6 (0.6 mg/kg) and magnesium (6 mg/kg) for six months.<sup>36</sup> Supplementation safely improved symptoms in 23 of the 33 children, with the most powerful effects seen in social interactions and communication.



### VITAMINS A AND C

Further improvements in the symptoms of autism have been observed with vitamins A and C. Vitamin A is essential for rapidly growing tissue such as gut, brain, and nerves—systems that malfunction in autism. Deficiencies in vitamin A have been noted in some individuals with autism.<sup>5,37</sup> In one study, supplementation with vitamin A for three months or longer produced improvements in eye contact, social skills, and sleep in children with autism.<sup>38</sup> Vitamin A is stored in body fat, and high levels can be toxic, so it is best to determine a safe dose in consultation with your physician or nutritionist.

Vitamin C, on the other hand, has dual biochemical and antioxidant roles, as well as being an important co-factor in the production of nerve-signaling chemicals.<sup>5,39</sup> A 1993 study of high-dose supplementation with vitamin C (8 grams per 154 pounds of body weight) in 18 autistic children revealed improvements in their measures of social relationship to people, observed emotional responses, and sensory responses. These improvements disappeared when the supplements were replaced by placebo.<sup>40</sup>

## CHELATION THERAPY

Chelation therapy is a controversial form of treatment for children with autism and related disorders.<sup>61</sup> Developed originally for treating known lead poisoning in children, the treatment involves dosing a child with one of several chemicals to bind and excrete mercury and other toxic heavy metals. Unfortunately, chelating drugs can also bind and remove essential nutrients, such as calcium and iron, from the child's body.<sup>62</sup>

Although chelation is recommended by some experts for the treatment of autism, success rates with this therapy have been conflicting. Some studies show evidence of increased exposure to mercury and other heavy metals in children with autism.<sup>63</sup> However, one recent carefully controlled study was unable to demonstrate chelatable levels of heavy metals, including mercury and lead, in children with autism,<sup>64</sup> and other recent studies have also questioned this association.<sup>65</sup> Although there are a few studies that demonstrate improvements in autistic children following chelation therapy,<sup>5,66</sup> there have also been reports of at least two deaths in children as a result of this therapy.<sup>62</sup>

While there is no question that environmental toxins pose a threat to children's health,<sup>67</sup> and that they could contribute in some ways to behavioral and developmental disorders,<sup>68</sup> parents should only elect chelation therapy for their autistic child with the considered advice of experienced practitioners.<sup>69,70</sup>

Several nutritional tactics can be used to minimize the stress of chelation therapy, and to maximize any effectiveness. Multivitamin and mineral supplements (without copper) help replace lost nutrients and maximize antioxidant effects. Similarly, zinc, selenium, vitamins C and E, and coenzyme Q10 contribute further antioxidant effects and augment the recovering liver's ability to eliminate toxins.<sup>5</sup> Glutathione levels should be supported by supplying sulfur sources such as glutathione itself, as well as components needed to make it, such as taurine, glycine, and magnesium. Another useful source of sulfur is methylsulfonylmethane, or MSM. Lipoic acid not only helps replenish glutathione, but also binds some heavy metals itself. The combined effect of these supplements is to boost the liver's antioxidant capacity and increase its ability to eliminate toxins.<sup>5</sup>

Preliminary evidence suggests that cilantro extract may naturally bind with toxic heavy metals such as mercury and lead, and many integrative practitioners now recommend this herbal extract to their patients undergoing chelation therapy.<sup>71,72</sup> Lactobacilli and bifidobacteria are probiotic organisms that may transform toxic mercury compounds into those that are more readily excreted from the bowel.<sup>23</sup>

## NUTRIENTS TO SUPPORT DETOXIFICATION

Boosting the body's detoxification system has yielded impressive benefits in combating autism. Children with autism often demonstrate impaired ability to detoxify harmful compounds from food, water, air, and byproducts of the body's own metabolism. Due to these faulty elimination systems, toxic compounds that would normally be quickly neutralized can linger, damaging the delicate nervous system.

The most important detoxification systems in the body require sulfur in a variety of forms to function effectively.<sup>3,24</sup> Sulfur compounds such as glutathione, and sulfur-containing amino acids methionine, cystathionine, and cysteine, are often depleted in autistic children, yet are crucial in the enzymatic destruction of toxins, such as phenolic compounds and tyramine, known to be harmful in autism.<sup>41,42</sup>



In 2002, Lonsdale reported improvements in behavior, speech, and communication in 8 out of 10 autistic children with the sulfur-containing vitamin B1 derivative, thiamine tetrahydrofurfuryl disulfide (TTFD), at a dose of 50 mg twice daily, which also promoted the excretion of some toxic metals in the urine.<sup>43</sup> While not yet widely available, TTFD is beginning to reach the dietary supplement market in specialty products targeted at boosting detoxification.

Another promising approach to enhancing the detoxification capabilities of individuals with autism is supplementation with substances that promote healthy levels of glutathione. This substance occurs abundantly in the livers of healthy people where it facilitates the removal of toxins from the body. Natural glutathione taken orally reduces inflammation in the gut, but is not well absorbed from the gut into the bloodstream.<sup>44</sup> As people with autism have lower levels of glutathione,<sup>42</sup> supplementation with nutrients that are converted to glutathione, such as glutamine, N-

acetylcysteine, lipoic acid, and glycine, can ensure a ready supply of glutathione for the liver.<sup>5</sup>

An alternate approach to ensuring healthy glutathione levels is to supplement with folic acid (an active form of folic acid naturally found in food), betaine, and methyl-cobalamin (vitamin B12), all of which are necessary in converting sulfur-containing compounds to glutathione, making it available for its crucial role in neutralizing toxins that may contribute to the symptoms of autism.<sup>42</sup>

## **OTHER VITAMINS AND NUTRIENTS THAT MAY BENEFIT AUTISM**

Significant improvements in social interaction, communication, and sleep disturbances in autistic individuals have been seen with folic acid, tetrahydrobiopterin (BH4, a chemical derived from folate), iron, and L-carnosine.

Folic acid is a B vitamin that is critical for nervous system development in children, which has been reported via parent questionnaire responses to improve behavior in autistic children.<sup>5</sup> In addition, two small studies have shown that folic acid supplements improve motor skills<sup>45</sup> and behavior in children with autism.<sup>46</sup>

Children with autism often display behavioral problems such as repetitive movements and restlessness, and can occasionally experience psychomotor regression (loss of previously attained motor skills). Supplementing with folic acid may help avert these troubling symptoms.

Furthermore, research suggests that tetrahydrobiopterin (BH4), a folate derivative and an essential co-factor in the synthesis of the neurotransmitters dopamine, epinephrine, and serotonin, may play a role in autism. In 2005, Swedish scientists treated 12 boys aged 4-7 years, who had autistic disorder and low concentrations of tetrahydrobiopterin, with daily doses of BH4 (3 mg/kg body weight) or placebo for six months.<sup>47</sup> Using an autism rating scale to assess the boys' behavior, the researchers noted significant improvement in social interaction, one of the core symptoms of autism, among the treated group compared with controls. While BH4 is not yet widely available as a dietary supplement, folate and S-adenosylmethionine (SAMe) influence its synthesis in the body.<sup>48,49</sup>

Iron deficiency has also been implicated in autism. A recent study revealed that 77% of a group of children with autism spectrum disorder were deficient in iron. Remarkably, iron supplementation significantly improved sleep disturbances in these children. This finding suggests that all children with autistic disorder should be screened for iron deficiency as part of their regular medical care, and that they should be treated with iron as indicated.<sup>50</sup>

Notable benefits for children with autism have been discovered using L-carnosine, a dipeptide that is a potent antioxidant.<sup>39</sup> The nutrient is perhaps best known for protecting against damaging glycation (non-enzymatic binding of a sugar with a protein) reactions, which have been implicated in aging and in the complications of diabetes.<sup>51</sup> L-carnosine appears to be highly beneficial in autistic subjects, successfully improving socialization, communication, and vocabulary.<sup>52</sup>

## **ESSENTIAL FATTY ACIDS**

Essential fatty acids, particularly the omega-3 fatty acids known as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are cell membrane components that are crucial in normal nerve and blood cell development and function.<sup>5</sup> A number of studies have revealed these omega-3 fatty acids to be deficient in the majority of children with autism.<sup>53-55</sup> Supplementation with essential fatty acid-rich fish oils has been shown to correct these deficiencies.<sup>56</sup> Many physicians believe that their autistic patients benefit from omega-3 supplementation in terms of behavior control and learning.<sup>5</sup> Essential fatty acids are also important in fighting the increased inflammatory response seen in many autistic children.<sup>57-59</sup>

Most recently, Austrian researchers published a double-blind placebo-controlled pilot study comparing omega-3 fatty acid supplementation with placebo in 13 autistic children aged 5-17 years who had severe tantrums, aggression, or self-injurious behaviors.<sup>60</sup> After six weeks of treatment with either placebo or 1.5 g/day of omega-3 fatty acids containing 800 mg of EPA and 700 mg of DHA, the treated group showed noticeable improvement on a behavior-rating scale for hyperactivity and stereotypical behavior. No adverse effects were noted, and the researchers concluded that this study provided "preliminary evidence that omega-3 fatty acids may be an effective treatment for children with autism."

## **CONCLUSION**

Autism has appropriately been called "an extreme challenge to integrative medicine."<sup>5</sup> At the same time, integrative medicine and nutritional approaches offer tremendous promise for the future of this heartbreaking group of disorders. Autistic children's quality of life can be greatly improved even with what we now know. We can have high hopes that the growing interest of the scientific community will result in urgently needed research to defeat autism within our lifetimes.

## RESOURCES FOR THOSE AFFECTED BY AUTISM

Many organizations are dedicated to providing information and support for families who are affected by autism. For more information, please visit the websites below:

ACT Today! <http://www.act-today.org>

AutismLink <http://www.autismlink.org>

Autism One <http://www.autismone.org>

Autism Research Institute (ARI) <http://www.autism.com>

Autism Society of America (ASA) <http://www.autism-society.org>

Autism Speaks <http://www.autismspeaks.org>

Centers for Disease Control <http://www.cdc.gov/actearly>

Doug Flutie Jr. Foundation for Autism Inc. <http://www.dougflutiejrfoundation.org>

First Signs Inc. <http://www.firstsigns.org>

National Autism Association <http://www.nationalautismassociation.org>

Organization for Autism Research Inc. <http://www.researchautism.org>

Special Needs Network <http://www.specialneedsnetwork.net>

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