Diets for Autism Spectrum Disorder: Learning from IBD and IBS Treatments

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The Relationship Between Digestion and Behavior

In this article, we focus on children who have been diagnosed with autism spectrum disorder (ASD) and also have gastrointestinal (GI) issues. In particular, we are interested in the connection between GI issues, the microbiome, and ASD-related symptoms. We put forward the concept that diets recently shown to be advantageous in managing chronic digestive ailments such as Crohn's disease and irritable bowel syndrome (IBS) have components that may benefit a subset of children with autism. In addition, we see a (not too distant) day in which behavioral problems often associated with ASD, particularly irritation, aggression, and self-harm, are well managed by a variety of interventions that modulate the microbiome.

As early as 1971, physicians began reporting GI issues associated with autism.[1] One 2002 survey noted at least one GI symptom in 76% of 112 consecutively examined children with ASD.[1] Until recently, the mainstream medical community did not pay attention to the link between GI issues and ASD symptoms. However, as exhibited by this excerpt from a 2014 article in the *Harvard Review of Psychiatry*, perspectives have shifted[2]:

> A preponderance of evidence suggests that a significant subset of autistic individuals exhibit GI abnormalities and that GI issues can contribute to the clinical manifestations of ASD-associated symptoms, including abnormal behavior, immune dysregulation, and metabolic dysfunction.

Within this "preponderance of evidence" we would like to point to two studies in particular that highlight the relationship between GI issues and ASD-associated symptoms: the first showing strong correlation and the second pointing to GI symptoms as exacerbating behavioral problems.

In a 2013 study, researchers drew upon child and adolescent medical records from a network of 17 autism centers across the United States and Canada.[3] An examination of 2,973 records showed that 24% of the children experienced at least one chronic digestive issue, including constipation, abdominal pain, bloating, or diarrhea. In addition, the presence of these digestive issues was predictive of diagnoses of anxiety and sensory overresponsivity (SORS). The correlation was strong enough that an anxiety or SORS diagnosis could be used to predict the presence of chronic GI problems, except diarrhea.

The second study, a 2010 consensus report on GI issues and autism, published by the Academy of Pediatrics, pointed toward a causal relationship between GI issues and worsening behavior.[4] The authors advise, if the behavior of a child with ASD is deteriorating, to look for a medical issue—in particular—to check for a GI issue. The article notes that for a child with ASD, the response to abdominal pain or discomfort may manifest in a variety of "vocal behaviors," "motor behaviors," or "changes in overall state." Within these categories the article provides a table of over 30 behaviors ranging from sighing, groaning, and screaming to grimacing, gritting teeth, unusual posturing, increased irritability, repetitive motions, self-injurious behaviors, and aggression.

These two articles strongly support the idea that digestive issues in children with ASD are interrelated with behavioral issues, with the latter report pointing to a causative role:

GI problems → worsen → ASD-related behavior

Other studies have also pointed to this relationship, observing that "gastrointestinal problems are associated with autism severity"[5] and low levels of essential vitamins, minerals, and amino acids contribute to worsening ASD symptoms.[6]

How Does the Intestinal Microbiome Fit into the Picture?

Obvious GI issues include constipation, diarrhea, reflux, bloating, IBS, and inflammatory bowel disease (IBD), which includes Crohn's disease and ulcerative colitis. Subtle GI issues include an unbalanced microbiome, often marked by lack of bacterial diversity.

The presence of obvious GI issues is also accompanied by an altered intestinal microbiome. Non-ASD studies have shown an unbalanced microbiome in chronic constipation,[7] diarrhea,[8,9] reflux,[10] IBS,[11] and certainly in chronic autoimmune issues such as Crohn's disease[12] and ulcerative colitis.[13]

At this time, multiple studies have found altered gut microbiota in children with autism. Findings from these studies indicate the following:

- Fecal flora of autistic children is significantly different from that of non-ASD siblings and healthy controls.[14,15]
- Microbiome conditions reduce the ability to metabolize carbohydrates.[16,17]
- Less diverse bacteria in the intestines.[16]

In addition to altered intestinal bacteria, studies have shown that a significant number of children with ASD have increased intestinal permeability, with one study noting increased permeability in 26% of 116 children with ASD.[18]

Another ASD microbiome study documented an unexpected observation: The "presence of autistic symptoms, rather than the severity of GI symptoms, was associated with less diverse gut microbiomes."[16] In other words, the presence of ASD-related behavioral symptoms acted as a better indicator of an unhealthy microbiome than GI issues.

Working with the Microbiome

A 2013 publication in *Nature* demonstrated that dietary changes could start shifting the microbiome in human subjects within 24 hours of food reaching the intestine.[19] The researchers were not attempting to elicit a therapeutic effect, only to show that the human gut microbiome was "rapidly" and "reproducibly" changeable via diet. In the same time period, researchers from Caltech used mice bred to exhibit ASD symptoms for a probiotic experiment.[20] They found that the probiotic changed the composition of the gut microbiota, healed intestinal permeability, and led to dramatic improvements in repetitive and anxiety-like behaviors.

Given that the gut microbiome is alterable via diet as well as probiotic supplements and foods,[21] it would follow that improving the health of the intestinal microbiota could positively influence ASD symptoms.

Finding a Diet Suitable for Autism

The role for ASD interventions involving diet and supplements has a mixed history, with most research energy focused on the gluten-free casein-free diet, or GFCF. Unfortunately, the results of GFCF studies have failed to show that the diet is effective.[22]

Although funding for gut microbiome research has increased significantly and a recent survey showed that nearly 40% of parents tried a special diet at least once for their children with ASD,[23] relatively few dietary studies are undertaken. First, with more variables to control, diets are inherently more difficult than studying pharmaceuticals. In addition, there is little financial incentive. The *Wall Street Journal* once described the situation as the "grim reality of medical research": "Doctors don't accept treatments that aren't validated by controlled studies, and drug companies, which fund most medical research, pay to study pills, not diets."[24]

Knowing of the funding situation for diets, and while looking for viable "autism diet" candidates, it helps to look at approaches being taken in other microbiome-connected illnesses involving digestive ailments.

Using Diet to Change the Microbiome in Inflammatory Bowel Disease and IBS

Research has determined that the microbiome plays a key role in the manifestation of Crohn's disease and ulcerative colitis symptoms as well as IBS. These digestive disorders share several characteristics of children with autism and GI issues, including a less diverse microbiome, an unbalanced microbiome, and increased intestinal permeability.[12,13]

Dietary approaches that have shown clinical efficacy in the medical literature include exclusive enteral nutrition (EEN), a low-FODMAPS diet, and the specific carbohydrate diet (SCD).

Exclusive Enteral Nutrition

EEN involves receiving nutrition from a feeding tube—not by mouth—where fats, carbohydrates, and sometimes proteins are broken down, making them easier to digest. When used exclusively, EEN has been shown to shift the microbiome, decrease intestinal permeability, and lead to remission in up to 85% of newly diagnosed pediatric patients with Crohn's disease.[25] Patients studied under this regimen have shown a reversal of malnutrition, healing of the intestinal mucosa, and a decrease in inflammatory markers.

In practice, the drawbacks of EEN include low acceptance and compliance. In addition, when Crohn's patients return to a regular diet, more than 60% of them relapse.

Low-FODMAP Diet

FODMAP is an acronym for fermentable oligo-, di-, monosaccharides and polyols. The low-FODMAP diet is premised on the idea that certain rapidly fermentable short-chain carbohydrates are poorly digested in the gut, leading to abdominal pain, bloating, diarrhea, and constipation. By removing or reducing these carbohydrates, studies have shown consistent symptom relief for approximately 74% of IBS patients.[26]

The low-FODMAP protocol is quite detailed with food lists readily available online. It is notable in that it removes gluten, high levels of lactose, and high fructose corn syrup from the diet.

One critical observation of the low-FODMAP diet is that it removes foods that feed beneficial bacteria in the intestine.[27] A 2015 study on the impact of a low-FODMAP diet on the microbiome appears to corroborate that observation.[28] This study showed that the low-FODMAP diet reduces total intestinal

bacteria, but the relative proportion of beneficial bacteria remained the same. In contrast, a typical Western (in this case Australian) diet was associated with the growth of beneficial bacterial groups. Because a low-FODMAP diet was not associated with the growth of beneficial bacteria, the authors of the study recommended caution if using this diet for long periods of time.

As of yet, a low-FODMAP diet has not been formally used for GI issues related to ASD. From our perspective, a low-FODMAP diet for autism would need to be modified to be casein-free. In addition, it would require probiotic supplementation to replenish beneficial bacteria.

Specific Carbohydrate Diet

Originally developed by Dr. Sidney Haas and used for celiac disease from the 1920s to 1950s,[29] the SCD was revitalized in the 1980s through the early 2000s by Elaine Gottschall for use in IBD, IBS, and celiac disease.[30]

The diet is premised on the idea that certain types of carbohydrates are not being fully digested, leading to an overgrowth of harmful bacteria in the small intestine. Notably, the diet avoids many complex carbohydrates, including bread, rice, and potatoes. In addition, added sugars and food additives are removed. The goals are to restrict the intake of certain types of carbohydrates, not quantity, as well as to replenish beneficial intestinal bacteria through probiotic foods and supplements.

In recent studies, including those conducted at Seattle Children's Hospital,[31] Rush Medical Center in Chicago,[32] and Children's Healthcare in Atlanta,[33] the SCD has been shown to improve the health outcomes of patients with Crohn's disease and ulcerative colitis, both autoimmune diseases in which the intestinal microbiome plays a central role. The SCD works by shifting the composition of the intestinal microbiome, including increasing bacterial diversity.[34] The improved patient outcomes in these studies have ranged from medication reduction and partial alleviation of symptoms to full remission.[31–33] Children responsive to the diet have maintained normal growth trajectories for height and weight.[31] In cases of symptom remission in IBD, it can be assumed that the effect of the SCD included a reduction of intestinal permeability.[35]

Modifying the SCD for Use in ASD

From the results of recent studies, including one from Seattle's Children Hospital describing the clinical use of the SCD within an academic center,[36] this diet appears to be a strong candidate for use with ASD—with one modification—using a casein-free version of the diet.

The use of a casein-free version of the diet is warranted by multiple reports of increased casein antibodies in the blood of children with ASD. One 2013 study followed 162 consecutively recruited ASD subjects who were using services at a neuropsychiatry unit.[18] After ruling out the possibility of celiac disease, researchers found casein antibodies "more frequently" in ASD subjects than in controls. In addition, the antibody levels were "significantly higher" than in controls.

In 2004, a casein-free SCD was reported to work well by several parents of children with ASD and has been extensively used in clinical practice by several U.S. healthcare practitioners—including one of the co-authors.

As of this writing, The Johnson Center for Child Health & Development located in Austin, Texas, is in the last stage of a pilot study to test a casein-free SCD for children diagnosed with both ASD and GI symptoms. Depending on the health of the subject, treatment was adjusted to include probiotic supplementation and/or digestive enzymes.

Diet Commonalities

It is notable that EEN, the low-FODMAP diet, and SCD either explicitly or implicitly decrease the intake of harder-to-digest carbohydrates, such as starches and disaccharides. For enteral nutrition, the carbohydrates are already broken into simple sugars. Both the SCD and the low-FODMAP diet specifically limit certain types of carbohydrates, although the types vary greatly between the diets.

The impact of undigested carbohydrates has been pointed out before in ASD. In a 2011 *PLoS ONE* article, researchers examined the gut microbiota of ASD children through samples taken directly from the intestine (most microbiota studies for autism involve examining fecal samples).[17] The researchers noted the "impairment of carbohydrate ingestion" and that the undigested carbohydrates may lead to "dysbiosis, diarrhea, bloating, and flatulence."

GFCF Diet Note

In contrast to the SCD and a low-FODMAP diet, the GFCF places an emphasis on avoiding specific proteins. For people with autism, eating GFCF foods and not paying attention to other dietary aspects, particularly carbohydrate consumption, is unlikely to address common GI issues or positively impact gut microbiota. That said, both the SCD and the FODMAP diet are gluten-free and it is advisable that these diets for ASD also remain casein-free.

Going Forward

Less than a decade ago, dietary interventions for Crohn's disease and ulcerative colitis were ignored by the mainstream medical community. Now we are seeing positive therapeutic application of diets such as the SCD at major hospitals. The use of a casein-free SCD diet, or other diet, for autism may follow a similar trajectory.

From IBD and IBS dietary interventions such as the SCD, the low-FODMAP diet, and EEN, we can now say that:

Diet → Changes the microbiome → Positively affects GI function

As mentioned in the beginning of this article, there is a strong connection, likely causal, between the health of the gut microbiota and ASD-related symptoms. It is one small step further to make the connection for autism:

Diet → Changes the microbiome → Positively affects GI function → Improves behavior

In addition, for IBD, several studies are showing therapeutic effects from fecal microbiota transplant (FMT)—a process by which the intestinal bacteria are changed by implantation of donor bacteria.[37,38] As this treatment matures, "diet" in the relationship above, may be changed to "diet and/or FMT":

Diet and/or FMT → Changes the microbiome → Positively affects GI function → Improves behavior

In the near future, we expect to see both diet and FMT play a larger role in the treatment of people with both ASD and GI symptoms, reducing the literal pain they are experiencing, and allowing them to lead happier, fuller lives. ■

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