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NUTRITION, MICROBIOTA, AND AUTISM: HOW GUT FLORA INFLUENCES CHILD DEVELOPMENT

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ABSTRACT

This article summarizes how the gut microbiome, the immune system, and the central nervous system interact via the gut–brain axis to influence autism spectrum disorder (ASD) development. Early-life microbiota disturbances (antibiotics, hospital exposure, formula feeding) can produce dysbiosis, impair intestinal barrier function, and promote systemic and neuroinflammation. These changes may alter neurodevelopmental processes (neurogenesis, synaptogenesis, myelination), neurotransmitter systems, and microglial activation. Selective eating common in children with ASD can worsen nutrient deficiencies and microbiome imbalance. Clinical and experimental evidence — including microbiota transfer from children with ASD to germ-free mice and trials of microbiota transfer therapy (MTT/FMT) — indicate the microbiome can affect gastrointestinal and behavioral symptoms, though current evidence does not support microbiome modification as a definitive cure for ASD. Future research should clarify mechanisms linking neuroinflammation and microbiota alterations and determine safe, effective microbiome-based interventions.

Autism and the Microbiome: Exploring the Gut-Brain Axis for ASD Answers!

In the field of autism research, there is growing attention to the fascinating link between gastrointestinal (GI) health and the development of autism spectrum disorders (ASD). This connection, known as the gut-brain axis, is a complex system of biochemical signals connecting our GI tract and central nervous system (CNS).

Understanding this relationship opens new horizons in the study of autism in children and the development of promising treatments and support methods.

This term, coined by researcher Rebecca Knickmeyer, who studies the microbiome-brain connection, is key to understanding the mechanisms of ASD development.

There is growing evidence linking autism to neuroinflammation. This is an important area of research that can shed light on the mechanisms underlying autism and potentially open new treatments and interventions.

What is neuroinflammation?

Neuroinflammation is an inflammatory response in the central nervous system (CNS), which includes the brain and spinal cord. It can be triggered by a variety of factors, including infections, injuries, autoimmune reactions, and genetic predisposition.

How might neuroinflammation be linked to autism?

There are several hypotheses about how neuroinflammation may influence the development and manifestations of autism:

- Effects on brain development: Neuroinflammation can disrupt normal brain development by affecting neurogenesis (the formation of new neurons), synaptogenesis (the formation of synapses), myelination (the formation of the myelin sheath around nerve fibers), and synaptic plasticity (the ability of synapses to change over time).
- Synaptic dysfunction: Neuroinflammation can lead to disruption of synaptic function, which affects the transmission of nerve impulses and information processing in the brain.
- Alterations in neurotransmitter systems: Neuroinflammation can affect levels of neurotransmitters such as serotonin, dopamine, and GABA, which play an important role in regulating mood, behavior, and other brain functions.
- Microglia stimulation: Activation of microglia can lead to the release of neurotoxic substances that damage neurons.

Early life microbiota disturbances may contribute to the development of ASD!

Early events alter the composition of the microbiome:

Antibiotics: destroy both pathogenic and beneficial bacteria, leading to dysbiosis (an imbalance of the microbiome).

Hospitalization: exposure to hospital microbiota (often with resistant bacterial strains).

Formula feeding: formulas typically do not contain essential prebiotics and probiotics in the same amounts as breast milk, which can lead to a less diverse microbiome in infants.

Changes in the microbiome are associated with a higher incidence of ASD:

Observational studies: Many studies show a correlation between these early events and an increased risk of developing ASD.

Dysbiosis and ASD: Individuals with ASD often experience dysbiosis, characterized by decreased microbiota diversity, altered bacterial balance, and impaired intestinal barrier function.

Gut-brain axis: the microbiota plays a key role in communication between the gut and the brain. This "gut-brain axis" involves the nervous system (vagus nerve), the immune system, the endocrine system (hormones), and metabolites (products produced by bacteria).

Disruptions in the microbiota can affect:

- Immune system: causing systemic inflammation (including neuroinflammation), which, as we discussed earlier, is associated with autism.
- Metabolism: altering the production of neurotransmitters (e.g., serotonin) and short-chain fatty acids (SCFAs), which are important for brain health.

➢ Intestinal permeability: disruption of the intestinal barrier can allow bacteria and toxins to enter the bloodstream, which can impact the brain.

Children with ASD have peculiar eating behavior!

Key characteristics of selective eating behavior in children with ASD:

- Restricted diet: Children with ASD often eat a very limited number of foods.
- Texture and color rejection: Children may reject foods with a certain texture (e.g., soft foods) or color (e.g., green vegetables).
- Sensory sensitivities: Many children with ASD experience heightened sensory sensitivities to smells, tastes, textures, and appearance of food, which can lead to food refusal.
- Routine preferences: Children often prefer to eat the same foods at the same time in the same place. Any change can cause stress and food refusal.
- Rituals and quirks: Children may have specific rituals associated with mealtimes (e.g., arranging food in a certain order, requiring specific utensils).
- Social interaction challenges: Eating selectivity can make it difficult to participate in social activities, such as going to restaurants or celebrating holidays.
- Undernutrition: Selective eating behavior can lead to inadequate nutrient intake, which can negatively impact a child's growth, development, and overall health.
- High anxiety: This is often associated with a child's general anxiety, especially in unfamiliar situations or when introducing new foods.

Possible causes of selective eating behavior in children with ASD:

➢ Sensory issues:

➢ Hypersensitivity: Increased sensitivity to tastes, smells, textures, and temperature.

➢ Hyposensitivity: Decreased sensitivity to certain sensations, which can lead to intense sensation seeking (e.g., crunchy foods).

➢ Fear of novelty: Children with ASD often experience anxiety before new experiences, including new foods.

➢ Lack of interest in food: Some children may simply not show sufficient interest in food.

➢ Motor problems: Problems with chewing, swallowing, or hand-eye coordination can make eating difficult. Behavioral issues: Selective eating behavior can be caused by behavioral issues such as stubbornness, disobedience, or a desire to control a situation.

➢ Physiological factors:

➢ Digestive issues: constipation, diarrhea, and abdominal pain can cause food aversion.

➢ Allergies and intolerances: Allergies or intolerances to certain foods can cause discomfort and food refusal.

Important! If your child exhibits selective eating behavior, be sure to consult with a doctor, dietitian, psychologist, or specialist in applied behavior analysis. Early intervention and a personalized approach can significantly improve eating behavior and overall health.

Children with autism spectrum disorders (ASD) show differences in the composition of their gut microbiome!

The most significant discovery is the difference in the gut microbiota composition between children with autism and their neurotypical peers.

A systematic review and meta-analysis have reliably demonstrated that children with ASD often exhibit an alarming predominance of potentially harmful microbes and, unfortunately, a decrease in beneficial bacteria.

In particular, increased populations of Bacteroides, Parabacteroides, Faecalibacterium, and Clostridium have been observed. At the same time, beneficial Coprococci and Bifidobacteria appear to be in decline.

Many children with ASD experience gastrointestinal problems, which can impact their overall health and behavior.

As early as 1967, the Autism Research Institute (ARI) noted that most patients with autism exhibit some form of gastrointestinal disease. One such characteristic is the composition of the intestinal bacterial flora, which often differs from that of healthy children.

In particular, levels of Clostridium bacteria may be elevated, which some researchers believe is associated with increased carbohydrate cravings. Certain types of gut bacteria can synthesize substances that negatively impact the immune system and brain, triggering inflammatory reactions.

Bacterial metabolites, such as short-chain fatty acids (SCFAs), such as propionic acid, can have a negative impact. Propionic acid increases intestinal permeability, causes inflammation, impairs mitochondrial function, increases oxidative stress, and reduces levels of important brain molecules (antioxidants, neurotransmitters, omega-3 fatty acids).

Inflammation of the gastrointestinal mucosa disrupts nutrient absorption, often manifesting as constipation or diarrhea.

Many patients with autism experience an increase in lymphoid tissue in the intestines.

Furthermore, the ability to properly digest gluten and casein is impaired, leading to the formation of gliadomorphin and casomorphin (opioid peptides).

This hypothesis suggests that these peptides, similar in structure to morphine, may play a role in the pathogenesis of autism.

A Bold Experiment!

To understand how the gut microbiome influences autism manifestations, scientists conducted a bold experiment. They transplanted gut bacteria from children with autism into mice lacking their own microbiome.

Then, by crossing mice with the same bacterial "inheritance," the researchers carefully observed the behavior of their offspring.

The results were astonishing: mice that received the microbiome from children with autism were significantly less social and more likely to exhibit stereotypical behavior.

Understanding the role of the gut microbiome in the development and manifestation of autism spectrum disorders (ASD) opens new horizons for therapeutic approaches. The focus is shifting toward finding ways to influence the microflora.

As Kang, D., Adams, J.B., Coleman, D. et al. (2019) note in the study "Long-term benefit of Microbiota Transfer Therapy on autism symptoms and gut microbiota": "Altering the gut microbiome is a potential way to improve gastrointestinal (GI) and behavioral symptoms in children with ASD, and fecal microbiota transplantation can transform a dysbiotic gut microbiome into a healthy one by delivering a large number of commensal microbes from a healthy donor."

This study highlights the potential of fecal microbiota transplantation to restore the balance of gut microflora and, consequently, improve the condition of children with ASD.

Autism spectrum disorders (ASD) are often accompanied by various comorbidities, creating a complex picture to understand and treat!

Based on the research conducted, new perspectives are opening up for the development of therapeutic approaches aimed at improving the condition of people with ASD.

More and more data confirms the significant impact of gastrointestinal (GI) problems on the quality of life of people with autism spectrum disorders (ASD).

However, it is crucial to remember that at this stage of scientific development, we cannot reliably predict whether a specific intervention, such as altering the gut microbiota with domestically produced medications, will have a decisive impact on autism symptoms.

But by caring for the health of our own microbiota, we are taking an important step not only for our own well-being but also for the health of our future children.

After all, gut microbiota is passed from mother to child during birth, and healthy microbiota plays a key role in the development of immunity and overall health.

Therefore, maintaining GI health is of paramount importance for both future generations and for those already living with autism.

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