

Probiotics and Other Supplements for Autism Spectrum Disorder (ASD): A Comprehensive Review

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KEYWORDS

gut-brain connection,
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(asd), dietary
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ABSTRACT

Introduction: Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition characterized by social interaction challenges, communication difficulties, and repetitive behaviors. While ASD lacks a cure, there is a growing interest in supplements, notably probiotics, for potential benefits. Probiotics are live microorganisms with health potential due to their role in the gut microbiome. Gut-brain axis is a bi-directional communication system that connects the gastrointestinal (GI) tract and the brain.

Objective: This comprehensive review systematically searched scientific databases up to September 2023 to examine the use of supplements, particularly probiotics, in individuals with ASD. The review focused on addressing gut-related issues and improving behavior, speech, and overall well-being.

Methods: A systematic search across databases such as PubMed, PsycINFO, and Cochrane library was conducted using keywords like "probiotics," "supplements," "ASD," "gut dysbiosis," and "therapeutic interventions." Studies meeting inclusion criteria, including clinical trials, observational studies, and case reports, were considered.

Results: Several studies suggest that probiotics may improve behavior, brain activity, and eye contact in individuals with ASD by addressing gut dysbiosis. Lactobacillus reuteri and specific Bifidobacterium strains are recommended probiotics, but more research is needed to confirm their efficacy. This review also explores supplements like Vitamin B6, magnesium, Vitamin B12, Vitamin C, and Omega-3 fatty acids, which show potential in supporting speech and overall well-being in individuals with ASD. However, they are not a cure and should be used under professional guidance. The article also discusses supplements for adults with ASD, underlining the importance of consulting healthcare professionals before use and the necessity for further research to determine effectiveness and optimal dosages.

Conclusion: Probiotics and supplements offer potential benefits for individuals with ASD, but they should be seen as complementary therapies rather than cures. A holistic approach, including medical supervision, therapy, and dietary considerations, is crucial for addressing the complex needs of individuals with ASD. Further research is necessary to uncover the precise mechanisms and therapeutic potential of these supplements in enhancing the lives of those with ASD.

Categories: Neurology, Gastroenterology, Nutrition

1. Introduction and Background

Probiotics are live microorganisms that can provide health benefits when consumed in adequate amounts. They have been studied for their potential to improve cognitive function in people with ASD by addressing gut dysbiosis and the gut-brain axis. While some studies have shown promising results, there is no consensus on the curative effect of probiotics for ASD [1]. Gut-Brain Axis is a bi-directional communication system that connects the gastrointestinal (GI) tract and the brain. It involves complex interactions between the central nervous system (CNS), which includes the brain and spinal cord, and the enteric nervous system (ENS), which is a network of neurons that controls the digestive system. and ASD : There is evidence suggesting a link between ASD pathogenesis and gut-brain axis dysregulation. Researchers believe that an unhealthy gut may be a causative factor in ASD, and probiotics are being explored as a potential treatment option [2]. Improvement in Behavior: Several studies have reported improvements in the behavior of children with ASD after probiotic supplementation. These improvements may be attributed to the modulation of the gut-brain axis and the correction of dysbiosis [3]. Brain Activity and Eye Contact: Probiotics could improve the brain activity of preschoolers with ASD, providing important evidence for the connection between the gut and the brain . A study suggested that the decreased levels of certain metabolites may affect eye contact [4]. Gastrointestinal Dysfunction and Dysbiosis: Probiotics have show potential benefits in improving gastrointestinal dysfunction

and correcting dysbiosis in some clinical studies [5]. This may indirectly contribute to improved cognitive function in individuals with ASD. *Lactobacillus reuteri*: This strain of bacteria, commonly found in probiotics, has been observed to improve social behavior in addition to gut problems. It is one of the strains that have been studied for its potential benefits in individuals with ASD [6]. While the use of probiotics for improving cognitive function in people with ASD shows promise, more research is needed to establish their effectiveness and identify the most appropriate strains and dosages for different individuals.

2. Review

Methods:

In this comprehensive review, a systematic search of relevant scientific databases, including PubMed, PsycINFO, and Cochrane library, was conducted to identify studies and research articles related to the use of probiotics and other supplements in individuals with ASD. Keywords such as "probiotics," "supplements," "ASD," "gut dysbiosis," and "therapeutic interventions" were utilized to identify pertinent literature. The inclusion criteria for studies involved in this review encompassed clinical trials, observational studies, and case reports published up to the knowledge cutoff date in September 2023. The selected studies were assessed for Potential benefits of probiotics for people with ASD Probiotics, which are live microorganisms that provide health benefits when consumed in adequate amounts, have been studied for their potential benefits for people with ASD. While the research is still ongoing, some potential benefits of probiotics for individuals with ASD include: Improvement in Behavior: Several studies have reported improvements in the behavior of children with ASD after probiotic supplementation. These improvements may be attributed to the modulation of the gut-brain axis and the correction of dysbiosis [7]. Gastrointestinal Dysfunction and Dysbiosis: Probiotics have shown potential

benefits in improving gastrointestinal dysfunction and correcting dysbiosis in some clinical studies [8]. This may indirectly contribute to improved overall well-being for individuals with ASD. Brain Activity and Eye Contact: A recent study found that probiotics could improve the brain activity of preschoolers with ASD, providing important evidence for the connection between the gut and the brain. Another study suggested that the decreased levels of certain metabolites could affect eye contact [9]. Reduction in Anxiety and Social/Behavioral Problems: Some research suggests that probiotics containing *Lactobacillus*, particularly *Lactobacillus plantarum*, may reduce symptoms like anxiety and social or behavioral problems in children with ASD [10]. While these potential benefits are promising, it is important to note that probiotics are not a cure for ASD, which is a neurodevelopmental disorder. Discussing probiotic use with a healthcare professional before starting supplementation is recommended [11]. Examples of probiotic supplements that are recommended for people with ASD There are several examples of probiotic supplements that are recommended for people with ASD. These supplements are believed to improve gut health, which in turn may help with behavior and mood regulation in individuals with ASD. Some of the recommended probiotic strains and supplements include: *Lactobacillus reuteri*: This strain is commonly found in probiotics used for autism treatment [12]. It has been observed to improve social symptoms in individuals with ASD [13]. *Bifidobacterium* is another strain that is recommended for individuals with ASD and irritable bowel syndrome (IBS) [14]. MARYRUTH'S USDA Organic Liquid Probiotics: This liquid formula is easy to digest and absorb, making it a suitable option for those seeking a probiotic supplement [15]. Klaire Labs Ther-biotic Complete Capsules: These capsules are recommended for individuals looking to give a variety of bacteria, as they contain 12 different strains [16]. It is important to note that while probiotics have shown promising effects in improving gut health and potentially aiding in behavior and mood regulation in individuals with ASD, more research is needed to fully understand their benefits and the specific strains that are most effective. Figure 1 Figure 2

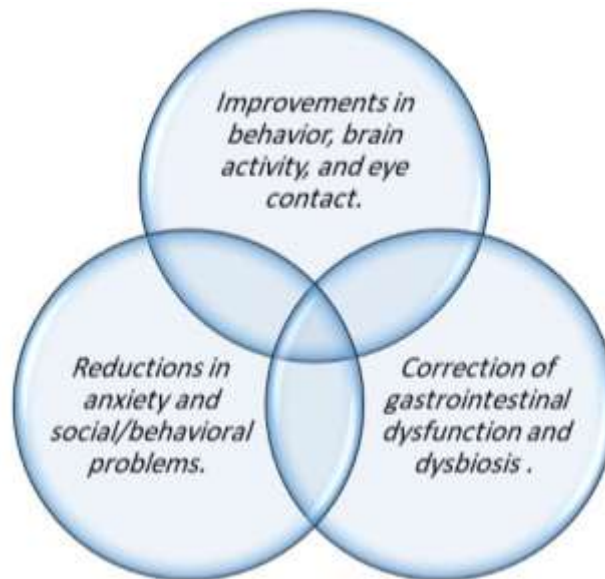


Figure 1: Potential Benefits of Probiotics for Individuals with ASD

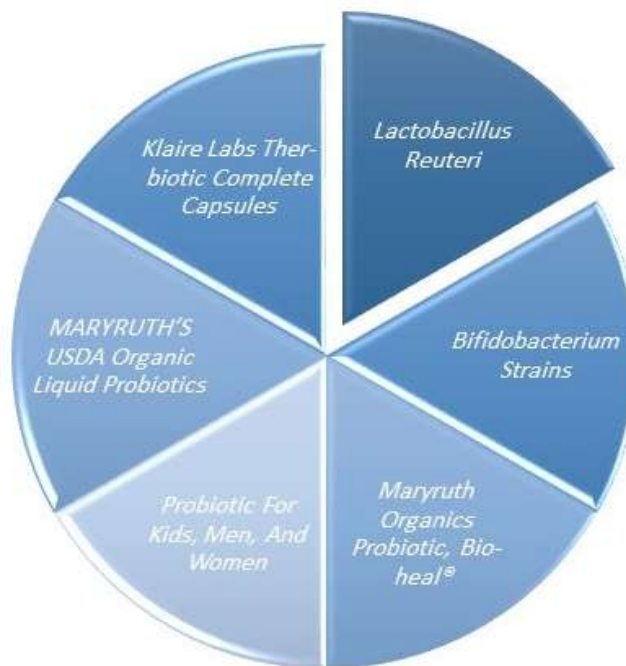


Figure 2: Recommended Probiotic Supplements for ASD

Potential benefits of probiotics for people with ASD

Probiotics, which are live microorganisms that provide health benefits when consumed in adequate amounts, have been studied for their potential benefits for people with ASD. While the research is still ongoing, some potential benefits of probiotics for individuals. There are several supplements that have been suggested to help with speech in individuals with ASD. While more research is needed to fully understand their effectiveness, some of the supplements that have been recommended for speech in ASD include: Vitamin B6: Vitamin B6 has been well-studied as a possible therapy for ASD and has been proposed as a therapy for speech in particular. It has been shown to have significant improvement in behavior, sleep, speech, learning, and social interaction in some studies [17]. Magnesium: Magnesium is another supplement that has been suggested to help with speech in individuals with ASD. Magnesium gluconate, magnesium aspartate, magnesium orotate, magnesium malate, magnesium citrate, or magnesium trout are some of the forms of magnesium that are recommended [18]. Vitamin B12: Vitamin B12 supplements have been shown to increase awareness and responsiveness, better focus, eye contact, socialization, and speech in children with ASD [19]. Vitamin C: Vitamin C supplements

have been shown to decrease stereotypical behaviors such as pacing, rocking, and hand flapping in children with ASD [20]. Omega-3 and Fish Oil: Omega-3 and fish oil supplements have been suggested to help with speech in individuals with ASD. Autistic children can have suboptimal levels of omega-3s, which can be improved with supplementation [21]. It is important to note that these supplements are not a cure for ASD and should be discussed with a healthcare professional before starting supplementation. Additionally, more research is needed to fully understand their effectiveness and the appropriate dosages for different individuals. Figure 3

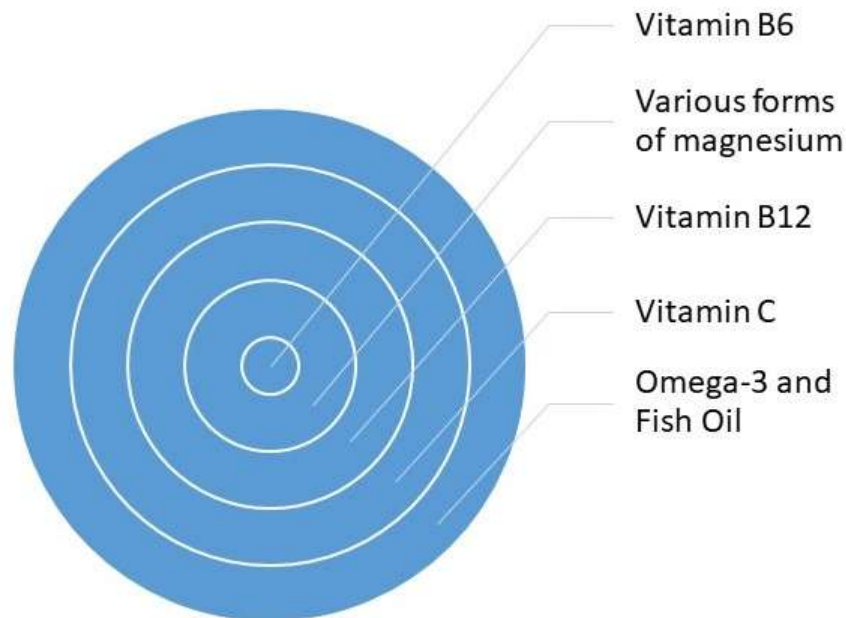


Figure 3: Recommended Supplements for speech in ASD patient

There are several supplements that have been suggested to help with various symptoms in adults with ASD. While more research is needed to fully understand their effectiveness, some of the supplements that have been recommended for adults with ASD include:

Vitamin D: Vitamin D supplementation has been suggested as a potential therapy for adults with ASD. Vitamin D plays a crucial role in brain development and function, and some studies have shown a link between vitamin D deficiency and ASD [22]. **Omega-3 and Fish Oil:** Omega-3 and fish oil supplements have been suggested to help with various symptoms in adults with ASD, including speech and communication. These supplements are rich in fatty acids that are important for brain health and development [23]. **Vitamin B6 and Magnesium:** Vitamin B6 and magnesium supplementation have been shown to have potential benefits for adults with ASD, including improvements in behavior and communication. These nutrients are important for neurotransmitter function and can help support overall brain health [24]. **Melatonin:** Melatonin is a hormone that helps regulate sleep-wake cycles, and some studies have suggested that it may be beneficial for adults with ASD who have sleep disturbances. However, more research is needed to fully understand its effectiveness and appropriate dosages for different individuals. [25] **Probiotics:** Probiotic supplements have been suggested to help support gut health in individuals with ASD, which may in turn have positive effects on overall well-being and behavior. However, more research is needed to fully understand the role of probiotics in ASD and the appropriate strains and dosages for different individuals. [26]. It is important to note that these supplements are not a cure for ASD and should be discussed with a healthcare professional before starting supplementation. Additionally, more research is needed to fully understand their effectiveness and the appropriate dosages for different individuals. Figure 5.



Figure 4: Recommended Supplements for Adults with ASD

Table 1 summary all probiotics and supplements used for ASD

Table 1: ASD Supplements summary

Supplements	Potential Benefits	Recommended Supplements for ASD
Probiotics	- Improved behavior, brain activity, and eye contact	- Lactobacillus reuteri - Bifidobacterium strains
	- Correction of gastrointestinal dysfunction and dysbiosis	- MaryRuth Organics Probiotic
	- Reduction in anxiety and social/behavioral problems	- Bio-Heal® Probiotic for Kids, Men, and Women
		- MARYRUTH'S USDA Organic Liquid Probiotics
		- Klaire Labs Ther-biotic Complete Capsules
Supplements for Speech	- Vitamin B6: Improvements in behavior, sleep, speech, learning, and social interaction	- Vitamin B6
	- Magnesium: Suggested for speech improvement	- Magnesium (glycinate, aspartate, rotate, etc.)
	- Vitamin B12: Increased awareness, better focus, and improved speech	- Vitamin B12
	- Vitamin C: Decreased stereotypical behaviors	- Vitamin C
	- Omega-3 and Fish Oil: Suggested for speech improvement	- Omega-3 and Fish Oil
Supplements for Adults	- Vitamin D: Potential therapy for adults with ASD	- Vitamin D
	- Omega-3 and Fish Oil: Suggested for various symptoms, including speech	- Omega-3 and Fish Oil
	- Vitamin B6 and Magnesium: Potential benefits of behavior and communication	- Vitamin B6 and Magnesium
	- Melatonin: Possible assistance with sleep disturbances	- Melatonin
	- Probiotics: Support for gut health, impacting overall well-being and behavior	- Probiotics

Recommendations:

Further Research: It is crucial to emphasize the need for continued research in the field of probiotics and supplements for individuals with ASD. Additional studies with larger sample sizes, rigorous methodologies, and long-term follow-up are necessary to establish the efficacy, safety, and optimal dosages of these

interventions. Researchers should also explore potential mechanisms of action to better understand how these supplements may benefit individuals with ASD.

Clinical Guidance: Individuals and caregivers should consult with healthcare professionals, such as pediatricians, neurologists, or dietitians, before starting any probiotic or supplement regimen for individuals with ASD. A health care provider can assess the specific needs of the individual, consider potential interactions with other medications or treatments, and provide personalized guidance on supplementation.

Holistic Approach: Stress the importance of a holistic approach to managing ASD, which includes not only supplements but also evidence-based therapies, behavioral interventions, speech therapy, and educational support. Probiotics and supplements should be viewed as complementary therapies, not as standalone treatments or cures.

Individualized Treatment: Recognize that ASD is a heterogeneous condition and that the effectiveness of probiotics and supplements may vary among individuals. Tailor treatment plans to the unique needs and characteristics of each person with ASD, considering factors such as age, coexisting medical conditions, and dietary preferences.

Transparent Labeling: Encourage individuals and caregivers to choose probiotic and supplement products with transparent labeling that clearly specifies the strains, dosages, and potential allergens. High-quality products from reputable manufacturers should be preferred.

Monitor and Assess: If individuals with ASD are using probiotics or supplements, healthcare professionals should monitor their progress, assess any changes in behavior, gastrointestinal symptoms, or speech development, and adjust the treatment plan as necessary. Regular follow-up appointments can help track the effectiveness and safety of supplementation.

Educational Resources: Provide educational resources and information to individuals affected by ASD and their families. This includes giving information on dietary choices, nutritional guidelines, and the potential role of probiotics and supplements in supporting overall well-being. Ensure that individuals and caregivers have access to evidence-based sources of information.

Government Regulations: Advocate for continued research funding and government oversight to ensure the safety and quality of probiotic and supplement products. Promote regulations that require rigorous testing and verification of health claims to protect the interests of individuals with ASD and their families.

Community Support: Encourage individuals and families affected by ASD to seek support from ASD-specific organizations, advocacy groups, and online communities. These resources can provide valuable insights, peer support, and practical advice on navigating the complex landscape of ASD management, including the use of probiotics and supplements.

By following these recommendations, individuals with a ASD and their caregivers can make informed decisions regarding the use of probiotics and supplements as part of a comprehensive approach to managing the condition. Additionally, healthcare professionals and researchers can contribute to advancing the knowledge and evidence base in this evolving field.

Limitations of this review include heterogeneity among study designs and populations may impact the generalizability of findings. Furthermore, the evolving nature of research in this field means that newer evidence may have emerged after the knowledge cutoff date. Finally, the review acknowledges the complex and individualized nature of ASD, making it challenging to provide one-size-fits-all recommendations for probiotics and supplements.

3. Conclusions

Despite the fact that probiotics and vitamins may be beneficial for those who have ASD, they should be seen more as complementing therapies than as cures. It is vital to use a holistic strategy that takes into consideration medical supervision, treatment, and nutritional factors in order to satisfy the complex needs of persons who have ASD. Additional study is required if the precise processes and therapeutic potential of these supplements are to be elucidated as a means of making life better for people with ASD.

Additional Information

Disclosures

Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work. No conflicts of interest to declare.

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