



Determinant Factors on Food Therapy in Autism Spectrum Disorder: A Synthesis of Literature Review

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Abstract

The increasing prevalence of Autism Spectrum Disorder (ASD) has spurred interest in alternative therapeutic approaches, including food therapy. This systematic literature review synthesizes existing research on the determinant factors influencing the effectiveness of food therapy in managing symptoms of ASD. The paper explores dietary interventions, such as gluten-free, casein-free (GFCF) diets, micronutrient supplementation, and probiotic use, and examines the biological, psychological, and social determinants that shape the efficacy of these interventions. The findings highlight the importance of personalized dietary plans, the role of the gut-brain axis, and the need for holistic approaches that consider both the physiological and psychosocial dimensions of ASD. Future research directions include longitudinal studies and clinical trials to establish clearer guidelines for food therapy in ASD management.

Keywords: Autism Spectrum Disorder, food therapy, gluten-free diet, casein-free diet, micronutrients, gut-brain axis, probiotics, dietary intervention.

Introduction

Autism Spectrum Disorder (ASD) is emerging as a complex neurodevelopmental condition. It is considered a spectrum because it encompasses a wide range of abilities and challenges, with each person with ASD presenting a unique combination of strengths and difficulties. ASD is health disorder that manifests through deficits in social communication, restricted interests, and repetitive behaviors (American Psychiatric Association, 2013). Early symptoms of ASD often include challenges in communication, such as facial expressions or gestures that do not align with verbal communication, along with sensory sensitivities to textures, colors, sounds, or smells (Sharma et al., 2020). These difficulties, along with repetitive behaviors and reduced



participation in social activities, can significantly impact a child's developmental trajectory and quality of life.

The underlying causes of ASD remain only partially understood, with a combination of genetic, environmental, biological, psychological, and dietary factors being recognized as contributing to the condition (Keller et al., 2021). However, the exact mechanism and interaction of these factors in the development of ASD are still under investigation. The variability in symptom severity and the individualized nature of the disorder necessitates a multifaceted approach to treatment that includes behavioral therapies, pharmacological interventions, and increasingly, dietary modifications.

Dietary interventions, commonly referred to as food therapy, have emerged as a promising complementary approach for managing ASD symptoms. These interventions target gastrointestinal (GI) issues, inflammation, and nutritional deficiencies, which are believed to exacerbate ASD symptoms (Christison & Ivany, 2006). This systematic literature review aims to explore the biological, psychological, and social factors that influence the effectiveness of food therapy for ASD, providing an integrated understanding of how dietary interventions can support cognitive and behavioral improvements in affected individuals.

Methods and Materials

A systematic literature search was conducted across three major databases: PubMed, Scopus, and Web of Science. The search focused on studies published between 2005 and 2025 (ensuring more than 75% of them published during last ten years), using a combination of relevant keywords and specific terms, including "Autism Spectrum Disorder," "food therapy," "dietary intervention," "GFCF diet," "micronutrients," "probiotics," and "gut-brain axis." Only peer-reviewed journal articles and scientific reports published in English were considered for inclusion. The search of literature aimed to gather a comprehensive set of studies exploring various dietary interventions as they relate to managing symptoms of ASD. With this, 51 readings were collected and only 32 were screened off from them for scientific analysis.

To ensure the relevance of the selected studies, specific inclusion and exclusion criteria were applied. Studies were included if they focused on dietary interventions specifically targeting ASD and addressed the biological, psychological, or social factors influencing the outcomes of food therapy. Eligible research designs included clinical trials, randomized controlled trials, and systematic reviews. Studies were excluded if they centered on general nutrition not directly related to ASD or if they comprised non-peer-reviewed literature or anecdotal evidence. This approach ensured that the review focused on scientifically rigorous and directly applicable findings.

Result and Discussion

Biological Determinants

It is argued that biological factors, such as genetic predispositions, brain structure abnormalities, and neurochemical imbalances, can be detrimental to the development of ASD.



These factors are believed to contribute to the neurological and developmental differences observed in individuals with ASD, affecting their cognitive, social, and behavioral functioning (Chakrabarti & Fombonne, 2005). Recent research further supports this notion, highlighting the role of prenatal factors and environmental influences on the development of ASD, particularly the genetic and hormonal contributions that shape neural development (Hoffman et al., 2024; Jalilzadeh Khalet Abad et al., 2025).

A key biological factor affecting food therapy in individuals with ASD is gastrointestinal (GI) dysfunction. Studies have shown that individuals with ASD frequently experience issues such as constipation, diarrhea, and abdominal pain, often linked to imbalances in gut bacteria, known as gut dysbiosis (Kandpal et al., 2022). The gut-brain axis, a two-way communication system between the gut and brain, plays a pivotal role in ASD. Probiotic supplements have demonstrated potential in restoring healthy gut flora, improving GI function, and easing related behavioral symptoms (Feng et al., 2023).

Additionally, food intolerances, particularly to gluten and casein, are significant biological considerations. Gluten-free and casein-free (GFCF) diets have been reported to reduce symptoms such as hyperactivity, irritability, and communication difficulties in some children with ASD (Al-Beltagi, 2024). However, the effectiveness of these diets remains a topic of debate, as certain studies and meta-analyses have found limited or no significant improvements in core ASD symptoms, highlighting the need for further research (Sathe et al., 2017).

Psychological Determinants

Psychological factors, such as emotional regulation, stress management, and coping mechanisms, play a crucial role in the health and well-being of individuals with ASD. These factors can significantly impact their social interactions, behavior, and overall mental health, with supportive interventions aimed at enhancing psychological resilience often proving beneficial in improving quality of life. Parental psychological factors, particularly perceptions and readiness, are crucial in determining the success of food therapy for children with ASD. The belief parents have in the effectiveness of dietary interventions, such as gluten-free and casein-free (GFCF) diets, directly influences their level of commitment. When parents have confidence in the benefits of such diets, they are more likely to follow through with consistency, which enhances the child's developmental progress (Narayanan, 2021; Alam et al., 2023).

On the other hand, the stress involved in managing a child with ASD can significantly impact how consistently these dietary interventions are applied. Parental anxiety, depression, or general emotional strain may lead to challenges in maintaining dietary restrictions, ultimately affecting the therapy's outcomes (Angel et al., 2025; Pérez-Cabral et al., 2024). Therefore, the mental and emotional well-being of parents must be prioritized to ensure the effective implementation of food therapy, as it plays a direct role in supporting the child's development and overall treatment success.

Social Determinants

An individual cannot exist in isolation from society and culture, as both play a critical role in shaping their health and well-being. In the case of individuals with ASD, social and cultural



contexts significantly influence their development, access to support systems, and overall quality of life, highlighting the importance of inclusive environments for their mental and emotional health. The socioeconomic status of families plays a crucial role in the effectiveness of food therapy, especially for managing ASD. Dietary interventions like gluten-free and casein-free (GFCF) diets often come with high costs due to the need for specialized foods and supplements. Families with limited financial resources may find it difficult to afford these items, restricting their ability to fully implement the diet and thereby reducing its potential benefits (Piwowarczyk et al., 2018). Additionally, limited access to healthcare professionals knowledgeable in ASD-related dietary therapies can further hinder the success of the intervention for families with fewer resources.

Cultural influences also impact the adoption of dietary interventions. In many communities, traditional food practices may conflict with the principles of specialized diets like GFCF, making it challenging for families to maintain these dietary changes. Cultural expectations around food can create barriers to adherence, especially when there is pressure to conform to long-standing culinary traditions (Baraskewich et al., 2021). To enhance the success and sustainability of food therapy in low-income and culturally diverse populations, it is important to address these socioeconomic and cultural factors.

Status and Recent Trends in ASD

According to the World Health Organization (WHO), approximately 1 in every 100 children globally is diagnosed with ASD, indicating a significant global prevalence. According to the National Census 2021, 2.25% of Nepal's total population (654,782 people) were identified as having some form of disability. This includes 2.5% of males and 2% of females. The prevalence rates for different disabilities are as follows: Physical (36.75%), Low vision (16.88%), Blindness (5.37%), Deafness (7.85%), Hard of Hearing (7.87%), Deafblind (1.56%), Speech impairment (6.36%), Psychosocial (4.2%), Intellectual (1.73%), Hemophilia (0.75%), Autism (0.75%), Multiple disabilities (8.78%), and Not stated (1.07%) (NSO, 2023). From 2008 to 2022, the number of diagnosed autism cases in Nepal grew significantly, starting with 11 cases in 2008 and reaching 325 cases by 2022, as reported by the Autism Care Nepal Society. The data shows a steady increase over the years, with notable spikes in 2021 and 2022. This rise is likely due to greater awareness, advancements in diagnostic techniques, and improved reporting practices during this time.

This prevalence, though lower than global averages, may reflect underreporting or diagnostic limitations. Developing countries like Nepal encounter challenges at the policy level, alongside issues related to parenting, food habits, drug use, and the availability of socio-psychological counseling services (Shrestha & Santangelo, 2014). These obstacles hinder the effective implementation of support systems for individuals with disabilities, further complicating their overall care and development. In more developed countries, such as the United States, the Centers for Disease Control and Prevention (CDC) estimates a higher prevalence, with 1 in 36 children diagnosed with ASD as of 2023 (Maenner et al., 2023). These disparities between



developed and developing countries may be attributed to differences in diagnostic capabilities, healthcare access, and societal awareness of autism.

Food Preference and Selective Eating In Children with ASD

Research consistently shows that children with ASD exhibit higher levels of food selectivity compared to neurotypical children. This selectivity is often associated with sensory sensitivities, repetitive behaviors, and gastrointestinal discomfort (Sharma et al., 2020). Studies have demonstrated that restrictive family eating habits further reinforce selective eating patterns in children with ASD (Bandini et al., 2017). Several factors contribute to food selectivity, including age, sensory modulation disorders, and sensory over-responsivity. For instance, children with ASD may avoid certain food textures or colors, leading to an unbalanced diet (Levin & Carr, 2021). Although numerous studies have reported these restrictive behaviors, few have proposed effective interventions to address them. Therapies focusing on feeding routines have shown promise, as children with ASD often respond positively to structured mealtime environments (Sharma et al., 2020).

The relationship between nutrition and mental health is well-established, with dietary patterns playing a crucial role in cognitive and emotional functioning. Recent research emphasizes the importance of focusing on dietary patterns, such as increasing the intake of fruits, vegetables, whole grains, seeds, and nuts, to promote better mental health outcomes (Bhat et al., 2023; Önal et al., 2023). Conversely, diets high in processed meats, added sugars, and unhealthy fats have been linked to poorer mental health and increased ASD symptoms. These findings underscore the need for dietary interventions that emphasize nutrient-dense, whole foods while minimizing processed and high-fat foods in managing ASD.

Importance of Social Activities and Physical Therapy with Food Interventions

Dietary interventions in ASD management should be complemented by physical activity and social engagement. Regular physical activity helps manage body weight, reduce stress, and release endorphins, which contribute to emotional well-being (Doreswamy et al., 2020). Children with ASD often face challenges in social interaction, and structured physical activities provide a valuable platform for developing social skills while also enhancing their physical health. Integrating trial-and-error dietary approaches with physical therapy can help caregivers identify which foods and routines work best for each child. This holistic approach aligns with the need for personalized treatments in ASD management, recognizing the unique physiological and psychological needs of each child including their communicative characteristics (Prelock et al., 2025).

Dietary patterns can also be influenced by cultural practices. In traditional diets, foods are often categorized into three groups: Tamasic, Rajasic, and Sattvic, which are believed to have different effects on emotional balance. Hindu Vedic texts assert that Tamasic and Rajasic foods are considered detrimental to both mental and physiological well-being, as they are believed to promote sluggishness, ignorance, and agitation in the mind. These foods are thought to hinder spiritual growth and the purity of the body, which is essential for achieving balance and self-realization (e.g., Tamasic foods such as meat, alcohol, and overly processed foods; Rajasic



foods like spicy, salty, and caffeinated items). On the other hand, Sattvic foods, which include fresh fruits, vegetables, and whole grains, are thought to promote mental clarity and tranquility (Bhat et al., 2023). These dietary choices may contribute to better management of ASD symptoms by promoting overall mental and emotional stability. However, while such dietary frameworks provide useful guidelines, individualized interventions remain essential in addressing the specific needs of each child with ASD.

Relation between Nutrition, Immune System and Nervous System in ASD

Emerging research highlights the role of the immune and nervous systems in the etiology of ASD. Studies suggest that ASD may result from a combination of genetic predispositions and environmental factors, including immune dysregulation and neuroinflammation triggered by environmental toxins (Schofield, 2016). The gut-brain axis, a critical communication network between the gastrointestinal (GI) tract and the brain, plays a key role in ASD. Disruptions in gut microbiota can negatively affect brain development and neurological function, leading to ASD symptoms (Ahmad et al., 2022). This understanding has led to growing interest in the use of probiotics and other gut-targeted therapies to modulate the gut microbiome and alleviate ASD symptoms.

Several studies have documented a high prevalence of GI symptoms in children with ASD, with reports indicating that up to 70% of children with ASD experience gastrointestinal issues such as constipation, diarrhea, bloating, and gastroesophageal reflux (GERD) (Ahmad et al., 2022). These findings suggest that addressing gut health through dietary interventions may be critical in managing ASD symptoms. For instance, probiotic supplementation has been shown to improve gut flora balance, reducing GI discomfort and positively impacting behavior and mood (Morton et al., 2023). The gut-brain axis thus represents a promising avenue for future research into the management of ASD.

Genetic Factor and Role of Parental Care in ASD

Genetic factors also play a significant role in ASD. Autism is believed to result from complex polygenic inheritance patterns, with several genes contributing to its development. Chromosomal abnormalities and neurological disorders are more common in families with ASD, and siblings of individuals with ASD are at a tenfold higher risk of developing the condition compared to the general population (Ganaie et al., 2014). Studies on twins have shown that identical twins are more likely than fraternal twins to both have autism, further underscoring the genetic basis of the disorder (Ramaswami & Geschwind, 2018).

Parental care and early intervention are crucial in managing ASD. Research shows that early nutritional interventions, especially during infancy, may help mitigate some of the long-term effects of ASD. For example, ensuring adequate zinc and magnesium intake during infancy has been associated with reduced severity of ASD symptoms (Oliveira Silva et al., 2023). Zinc deficiency, in particular, has been linked to various neurodevelopmental disorders, including ASD. The "infantile window" is a critical period for neurodevelopment, and addressing mineral imbalances during this time may offer potential for the treatment and prevention of ASD (Oliveira Silva et al., 2023).



Zinc Deficiency and the ASD

Zinc deficiency has been increasingly recognized as a contributing factor in the pathophysiology of ASD. Recent studies have shown that children with ASD often suffer from marginal to severe deficiencies in zinc and magnesium, as well as elevated toxic metal burdens, such as lead and mercury (Oliveira, 2013). These mineral imbalances can disrupt various biological processes, including immune system functioning, cellular repair, and detoxification pathways. The neurodevelopmental impact of zinc deficiency is profound, as zinc is critical for proper synaptic signaling, neuronal growth, and neurotransmitter function, particularly during the early stages of brain development (Grabrucker, 2012). Zinc's role as a cofactor for over 300 enzymes involved in DNA synthesis and repair also implicates it in the epigenetic regulation of gene expression, potentially influencing the severity and manifestation of ASD symptoms (Bjorklund, 2013).

The timing of zinc deficiency is especially important, with a critical "infantile window" in early neurodevelopment during which adequate zinc levels are essential for the formation of neuronal networks (Yasuda & Tsutsui, 2013). Deficiencies during this period may lead to irreversible impairments in cognitive and motor function, which are often observed in individuals with ASD. Beyond its neurodevelopmental role, zinc deficiency is also linked to a range of pathological conditions, including dysgeusia (taste disorders), delayed wound healing, impaired immune response, and retarded growth (Prasad, 2013). Given these wide-ranging effects, addressing zinc deficiency early in life may not only mitigate the risk of neurodevelopmental disorders like ASD but also improve overall physiological functioning in affected individuals. Therefore, future research should explore targeted zinc supplementation as a potential therapeutic intervention, particularly in populations at high risk for mineral deficiencies.

Synthesis of the Findings

The dietary approaches for managing ASD have gained increasing attention in recent years, especially as research uncovers the complex interactions between nutrition, brain function, and behavior in individuals with ASD. Ahmad et al. (2022) highlight the significance of various dietary interventions, such as supplementation with micronutrients (e.g., zinc, magnesium) and omega-3 fatty acids, which are believed to address deficiencies commonly observed in children with ASD. These interventions may mitigate symptoms like social withdrawal and communication difficulties, which are hallmarks of the disorder. The authors emphasize the importance of a holistic approach, integrating dietary management alongside behavioral therapies, to optimize outcomes for children with ASD.

In addition to the nutritional deficiencies, there is mounting evidence suggesting that gut health plays a crucial role in the manifestation of ASD symptoms. Alam et al. (2023) explore the role of the gut-brain axis in ASD, proposing that gastrointestinal issues, such as altered microbiota composition, could exacerbate the behavioral and cognitive symptoms associated with the disorder. They discuss the potential benefits of probiotics and prebiotics, which have been



found to influence the gut microbiome and, in turn, affect neurological and behavioral functioning. Similarly, Al-Beltagi (2024) in his systematic review confirms that early nutritional interventions could be pivotal in improving outcomes for children with ASD, particularly in relation to gut health and neuroinflammation. These insights stress the need for individualized dietary strategies, taking into account both biological and environmental factors to address the multifaceted nature of ASD.

Based on the scientific readings consulted for developing this paper, Table 1 presents a detailed synthesis that includes most of the citations from the provided articles, organized according to common themes and key findings. This synthesis table categorizes various aspects of autism spectrum disorders (ASD) and dietary interventions, such as nutritional management, diet-related challenges, and therapeutic approaches.

Table 1: Synthesis of Key readings on ASD regarding food therapy

Study	Key Findings	Themes	Nutritional Approaches	Limitations/Challenges
Ahmad et al. (2022)	Focused on dietary approaches for managing ASD, highlighting challenges in addressing nutritional needs.	Nutritional complexities of ASD	Advocates for dietary supplements, gluten-free, and casein-free diets.	Limited evidence on long-term effectiveness of dietary approaches.
Alam et al. (2023)	Reviewed dietary interventions for ASD, emphasizing gut-brain interactions.	Diet and brain health	Probiotics and gut microbiota manipulation in diet.	Inconsistent findings on the gut-brain axis in ASD.
Al-Beltagi (2024)	Systematic review on nutritional management, covering the role of micronutrients in ASD.	Nutritional management in ASD	Zinc, vitamin B6, and magnesium supplementation.	Limited randomized controlled trials (RCTs) and varied outcomes.
Baraskewich et al. (2021)	Examined feeding and eating problems in children with ASD, highlighting the prevalence of selective eating and feeding difficulties.	Feeding behavior and ASD	Focus on food selectivity and mealtime behavior.	Small sample sizes and lack of standardized assessment tools.
Bhat et al. (2023)	Investigated the role of nutrition in mental health, linking micronutrient deficiencies with ASD symptoms.	Mental health and nutrition	Role of zinc, iron, and other minerals in cognitive functions.	Generalization of results to ASD populations is limited.



Feng et al. (2023)	Explored probiotics in ASD, suggesting that gut microbiota may influence ASD symptoms through the gut-brain axis.	Gut-brain axis in ASD	Probiotics for gut health improvement.	Need for more clinical trials to validate findings.
Grabrucke r (2012)	Discussed environmental factors contributing to ASD, including the role of diet.	Environm ental factors in ASD	Environmental toxins and diet as potential contributors to ASD.	Lack of direct causal evidence for diet and environmental interactions.
Christison & Ivany (2006)	Investigated elimination diets (gluten/casein-free) in ASD treatment and found mixed evidence regarding effectiveness.	Eliminatio n diets in ASD	Gluten-free and casein-free diets (GFCF).	Variability in response among individuals; lack of long-term data.
Doreswam et al. (2020)	Examined the effects of diet, nutrition, and exercise on children with ASD, showing promising results for certain dietary interventions.	Diet, nutrition, and exercise interventio ns in ASD	Balanced nutrition, exercise, and diet.	Need for more large-scale studies and better dietary standardization.
Önal et al. (2023)	Reviewed dietary components and their role in treating ASD, highlighting deficiencies and nutrient imbalances.	Role of dietary componen ts in ASD	Emphasis on balanced diet and micronutrient intake.	Lack of consensus on the exact dietary interventions.
Piwowarc zyk et al. (2018)	Focused on the GFCF diet, analyzing systematic reviews and clinical trials on its effectiveness in ASD.	GFCF diets in ASD	Gluten-free and casein-free diets (GFCF).	Mixed results, with some children showing improvements, others no changes.
Sathe et al. (2017)	Reviewed nutritional and dietary interventions, confirming the lack of high-quality evidence but supporting the use of certain diets.	Systematic review on nutritional interventio ns in ASD	Balanced diet, omega-3 supplementation , and gluten-free diets.	Lack of RCTs, inconsistent outcomes across studies.



Sharma et al. (2020)	Examined food selectivity in children with autism and the impact of specific dietary restrictions on health.	Food selectivity in children with ASD	Managing food selectivity through structured feeding interventions.	Generalizability issues, as many studies involved small sample sizes and limited diversity.
Pérez-Cabral et al. (2024)	Explored dietary interventions in ASD, including vitamin and mineral supplementation and modified diets.	Dietary interventions in ASD	Vitamin D, zinc, and magnesium supplementation	Small studies with no clear guidelines on diet implementation.
Bjorklund (2013)	Investigated the role of zinc and copper in ASD, emphasizing their potential link to ASD behaviors.	Zinc and copper in ASD	Zinc supplementation for cognitive and behavioral improvement.	Limited understanding of the full role of micronutrients in ASD.

This review, hence, synthesizes the main findings from the scientific research works, addressing key themes such as the role of specific nutrients, diet-related challenges, and the effectiveness of various dietary interventions. Some studies emphasize dietary components such as probiotics, zinc, and the GFCF diet, while others highlight the need for more controlled and larger studies to understand the full impact of nutrition on ASD management. Despite encouraging findings, many studies point out the challenges of inconsistent results, small sample sizes, and the lack of high-quality evidence supporting the long-term benefits of these nutritional interventions.

Conclusion

The scientific studies highlight the multifaceted relationship between biological, psychological, and social factors that collectively determine the effectiveness of food therapy in individuals with ASD. Biologically, issues such as gut dysbiosis, food intolerances, and disruptions in the gut-brain communication system form the scientific basis for dietary interventions like gluten-free and casein-free diets, which aim to address both gastrointestinal and behavioral challenges in ASD. However, the efficacy of these interventions is further influenced by psychological and social dimensions. Parental attitudes, beliefs regarding the benefits of food therapy, and their ability to manage the stress associated with these dietary changes are crucial in maintaining adherence to specific regimens. Additionally, socioeconomic conditions, such as access to allergen-free foods and the affordability of specialized diets, play a pivotal role in determining the success of these interventions. Therefore, understanding the outcomes of food therapy for ASD requires considering both the underlying biological mechanisms and the broader psychosocial context within which these therapies are applied (Narayanan, 2021; Al-Beltagi, 2024).



The heterogeneity in ASD symptoms and severity across individuals underscores the importance of personalized dietary interventions tailored to the specific needs of each child. Furthermore, while some studies report positive outcomes from GFCF diets and probiotic use, others point to inconsistent results, suggesting the need for more robust, large-scale clinical trials to validate the findings. To conclude, food therapy presents a promising complementary approach for managing ASD symptoms, but its success is contingent upon multiple determinants, including biological, psychological, and social factors. Personalized interventions that consider these determinants, along with continued research through longitudinal studies, will be essential in optimizing dietary interventions for individuals with ASD.

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