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Overview of dietary patterns and vegetable/fish preferences among autistic children

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ABSTRACT

Global autism prevalence is rising, necessitating specialized dietary management. While gluten-free and casein-free (GFCF) diets, along with Omega-3 and antioxidant-rich foods, are recommended to manage symptoms and support brain development, many children with ASD still face significant nutritional challenges. This study aims to describe dietary patterns and preferences for vegetables and fish among children with autism in the Jabodetabek area. This mixed-methods cross-sectional study involved 112 parents of children with autism, selected via cluster random sampling. Data were collected using Food Frequency Questionnaires (FFQ), 2x24-hour food recalls, and in-depth interviews. White rice, tempeh, chicken, and spinach were the primary food sources consumed. Notably, 97% of children still consumed gluten and casein. While a majority expressed a preference for vegetables (61.6%) and fish (81.25%), driven by daily consumption habits, significant macronutrient deficiencies were identified. Specifically, 76.7% of children had insufficient carbohydrate intake, 60.7% lacked adequate fat, and 46.4% were protein-deficient. Autistic children exhibit substantial macronutrient deficits and low adherence to GFCF diets. These findings highlight a critical need for improved dietary education and nutritional interventions for this population.

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INTRODUCTION

Autism Spectrum Disorder (ASD) represents a complex neurodevelopmental condition characterized primarily by challenges in communication and social interaction (Wang et al., 2022). While there is currently no definitive cure for ASD, dietary therapy has emerged as a frequently utilized complementary approach in the management of associated symptoms (Al-Beltagi, 2024). However, the application of strict dietary protocols presents a dual challenge: while intended to mitigate behavioral exacerbations, restrictive eating patterns can significantly impact the nutritional status of growing children (Lim et al., 2024). To support optimal physiological growth and brain development, the diets of children with ASD must provide adequate amounts of essential macronutrients, including energy, protein, fats, and carbohydrates (Önal et al., 2022). Consequently, determining the type, quantity, and quality of food consumed is critical, as these factors directly influence both physical development and neurological outcomes in this vulnerable population (Nogueira-de-Almeida et al., 2025).

Among dietary interventions, the gluten-free and casein-free (GFCF) diet is among the most widely recommended strategies for managing autism symptoms (Zafirovski et al., 2024). The theoretical efficacy of the GFCF diet is often linked to the "leaky gut" hypothesis, which posits

that eliminating these proteins can improve digestive integrity and, in turn, alleviate behavioral symptoms (Fang et al., 2025). While adherence to this diet may reduce gastrointestinal distress and improve behavior, it requires avoiding specific food groups that are often primary sources of essential nutrients (Pérez-Cabral et al., 2024). Therefore, implementing a GFCF diet requires careful monitoring to ensure that the exclusion of gluten and casein does not lead to nutritional deficiencies that could hinder a child's development (Öztürk et al., 2026).

Beyond exclusion diets, the inclusion of specific bioactive nutrients, particularly Omega-3 polyunsaturated fatty acids (PUFAs), is gaining recognition for its potential therapeutic role (Barón-Mendoza & González-Arenas, 2022). Omega-3 fatty acids support brain function by modulating dopamine and serotonin, reducing gut-brain inflammation, and repairing synaptic membranes, which is crucial for children with ASD who may suffer from congenital PUFA deficiencies (Al-Ewaidat et al., 2025). Although no single treatment is universally effective for ASD, complementary interventions involving PUFAs may work alongside conventional medical and psychological therapies to reduce disruptive behaviors (Vandana et al., 2023). As fish is a primary dietary source of these fatty acids, understanding fish consumption patterns is vital for optimizing neuroprotective nutrient intake in autistic children (Alsaqer et al., 2022).

Furthermore, emerging research indicates that inflammation and oxidative stress play key roles in the pathogenesis and severity of ASD, suggesting that administering anti-inflammatory and antioxidant molecules may be a promising approach to combating pathological behaviors (Akhtar & Rahaman, 2025). Natural antioxidants, which are abundant in fruits and vegetables, possess significant anti-inflammatory properties and have been shown to modulate inflammatory pathways (Singh et al., 2022). High-antioxidant dietary interventions can reduce oxidative stress in the brain, potentially improving cognitive function and social behavior by modulating the gut microbiota (Długosz et al., 2024). Polyphenols found in various plant sources, such as berries and green tea, highlight the important role of nutrition in maintaining overall brain health, underscoring the need to assess vegetable and fruit preferences in this demographic (Shanmugam et al., 2022).

Given the background that consistent adherence to a GFCF diet, alongside adequate intake of PUFAs and antioxidant-rich foods, can alleviate various symptoms in children with ASD, there is a pressing need to evaluate current dietary practices (Pérez-Cabral, 2024). It remains unclear to what extent these therapeutic recommendations are being met in daily intake and how food preferences influence nutritional status (Esposito et al., 2022). Therefore, this study aims to provide a comprehensive overview of intake of these important nutrients, specifically examining vegetable and fish preferences, and monitoring gluten and casein intakes that should be avoided. By analyzing these dietary patterns, this research seeks to inform more effective nutritional strategies that balance symptom management with the physiological needs of children with autism (Yano & Hosokawa, 2023).

METHOD

Research Design

This study employed a mixed-method design, integrating both quantitative and qualitative approaches to provide a comprehensive understanding of dietary patterns among the target population. The combination of these methods enabled statistical assessment of nutrient intake alongside an exploratory analysis of dietary behaviors and preferences. This dual approach facilitated a deeper investigation into the relationship between specific dietary components and the management of autism spectrum disorder (ASD) symptoms within the study setting.

Participant

The study was conducted in special schools dedicated to children with autism spectrum disorder (ASD) located in the Greater Jakarta area. For the quantitative component, 112 respondents were selected using a cluster-random sampling technique. The participants included guardians, parents, or caregivers of children with ASD who were willing to participate in the study. Specific exclusion criteria were applied to ensure the homogeneity of the sample regarding physical comorbidities; these criteria included current illness during the study period, diagnosis of epilepsy, use of assistive devices such as wheelchairs, and paralysis. For the qualitative component, a subset of 10 respondents representing each school was selected to provide detailed insights into dietary experiences.

Data Collection

Data collection instruments were tailored to capture both nutritional metrics and behavioral contexts. Quantitative data were gathered using a Food Frequency Questionnaire (FFQ) to assess dietary habits and a 2x24-hour food recall method to determine total food intake. Qualitative data were collected through in-depth interviews, focusing on six key questions. These interviews sought to confirm adherence to special diets, identify disliked food textures, and evaluate the consumption patterns of plant-based and animal-based foods. This multi-instrument approach ensured that both the nutrient composition and the sensory aspects of the children's diets were recorded.

Data Analysis

The collected data were processed according to their respective methodological frameworks. Quantitative data from the FFQ and food recalls were analyzed to calculate nutrient intake levels, specifically focusing on energy, macronutrients, and the presence of gluten, casein, Omega-3, and antioxidants. Qualitative data from the in-depth interviews were transcribed and analyzed to identify recurring themes regarding dietary restrictions, texture aversions, and food preferences. The integration of these analyses provided a holistic overview of the dietary landscape for children with ASD in the selected schools.

Ethical Clearance

Ethical considerations were strictly adhered to throughout the research process to protect participants' rights and welfare. This study received formal ethical approval from the Ethics Committee of Universitas Prima Indonesia. The approval was granted under reference number 076/KEPK/UNPRI/VI/2024, ensuring that all procedures involving human subjects complied with established ethical standards for medical and nutritional research.

RESULT

Overview of the Dietary Patterns of Autistic Children in the Greater Jakarta Area

Table 1 shows that the diets of autistic children in the Greater Jakarta area are dominated by rice as the primary carbohydrate source. The primary source of fat is palm oil, used in daily food preparation 3–4 times per day. This data shows that autistic children's food intake remains focused on certain types of food, with limited variety.

Table 1. Overview of the dietary patterns of autistic children in the Greater Jakarta area

Food Groups	Food	Frequency
Carbohydrate	Rice	2-3x/day
Vegetable Protein	Tempeh	3-4x/week
Animal Protein	Chicken meat	3-5x/week
Seafood	Catfish	1-2x/week
Fat	Palm oil	3-4x/day
Vegetables	Spinach	3-4x/week

Distribution of Likes: Vegetables and Fish

Table 2 shows that most autistic children like vegetables (61.6%) and fish (81.25%), with a higher preference for fish than for vegetables.

Table 2. Description of preferences for vegetables and fruits

Preference	Like	Do not like
Vegetable	61.6%	38.4%
Fish	81.25%	18.75%

Distribution of Adequate Macronutrient Intake

Table 3 shows that most autistic children have macronutrient intakes in the deficient category. The highest deficiency was in carbohydrate intake (76.7%), followed by fat (60.7%) and protein (46.4%). Only a small proportion of children achieved adequate or higher intakes, suggesting that overall, macronutrient adequacy for autistic children in the Greater Jakarta area remains unmet.

Table 3. Distribution of adequate macronutrient intake

Macronutrient	Macronutrient Adequacy Intake Categories		
	Not enough	Enough	More
Protein	46.4%	29.4%	24.1%
Fat	60.7%	27.6%	11.6%
Carbohydrate	76.7%	21.4%	2.6%

DISCUSSION

Eating Pattern Overview

Carbohydrates are a macronutrient that primarily contributes energy to the body. In the FFQ interview results, rice was the most consumed carbohydrate source. As seen in Table 1, autistic children consume rice at every meal. This is because rice is a highly available carbohydrate source in many regions. Furthermore, rice is gluten-free, making it the most consumed carbohydrate source by autistic children (Ibrahim, 2022). Besides being readily available, rice also has a neutral taste, making it more readily accepted by autistic children, who often have specific food-sensory preferences. Regular consumption of rice at every meal indicates that autistic children's diets are still heavily reliant on a single primary carbohydrate source. This condition can lead to a lack of nutritional variety if not balanced with a variety of other carbohydrate sources. Food diversification is necessary to ensure adequate and balanced nutrition in the diets of autistic children (Mathew et al.,2022).

Regarding protein sources, tempeh is the most consumed vegetable protein. Among animal proteins, chicken is the most frequently consumed by autistic children. Seafood, a source

of animal protein, is the most consumed food by autistic children. Tempeh, chicken, and catfish are high-protein sources, and their affordability and availability make them the most frequently consumed foods. These foods are relatively easy to prepare and can be adapted to autistic children's texture and taste preferences. The adequate protein content in tempeh, chicken, and catfish is crucial for supporting growth, tissue repair, and metabolic function. This consumption pattern suggests that autistic children's protein needs are likely met by commonly consumed daily foods. However, a variety of protein sources is still important to ensure adequate intake of essential amino acids and other supporting nutrients (Roziana & Humaroh, 2025).

In Table 1, the most frequently consumed type of fat is palm oil. The FFQ interview results indicate palm oil consumption at every meal. Fat is a macronutrient that helps the absorption of vitamins A, D, E, and K, which support immune system function and bone health (Mandecka & Regulska-Ilow, 2022). Spinach is the most frequently consumed vegetable by autistic children. Healthy cognitive function, behavioral development (motivational behavior), sensory processing, and overall progressive maturation depend on vitamin A (Olson et al., 2024). Vitamin A is very abundant in spinach. Consuming spinach as a primary source of vegetables significantly contributes to meeting autistic children's vitamin A needs. Vitamin A plays a role in maintaining eye health and the immune system, as well as supporting optimal neurological function. Adequate vitamin A intake is expected to support the cognitive and behavioral development of autistic children. Furthermore, spinach also contains other vitamins and minerals, such as vitamin C, iron, and folate, which are beneficial for overall health (Qishawi et al., 2023).

GFCF Diet

Based on the analysis of the types of food consumed, it was found that the majority of autistic children (97%) still consume foods containing gluten and casein, whether from carbohydrate, protein, or fat sources. Only 3% of parents or guardians implement the GFCF diet for autistic children based on FFQ data. Another problem found during data collection is the lack of parental knowledge about the types of foods containing gluten and casein. One example of this lack of knowledge about gluten and processed products is that parents avoid giving their children white bread, fried foods, and cakes, yet still give their children commercial biscuits made from wheat. Therefore, this can also be linked to a lack of knowledge and skills in reading food labels on commercial products. Not only that, but some parents are also only aware of the prohibition on gluten consumption, but not for casein, so many autistic children still consume milk and processed products. These conditions indicate that the GFCF diet has not been optimally or comprehensively implemented. Parents' lack of understanding of gluten and casein sources, including those in processed products, can lead to a mismatch between dietary intentions and actual practices. Furthermore, limited information and education regarding the GFCF diet can impact parental compliance and consistency in managing the diets of autistic children. Comprehensive, ongoing nutrition education is necessary for parents or guardians to implement the GFCF diet effectively (Sharma, 2024).

Based on in-depth interviews with 10 respondents, only 3 parents implemented special diets, such as gluten-free diets, no cow's milk, and avoidance of foods containing sugar, MSG, and chocolate. The reasons for these special diets were hyperactivity and insomnia. The remaining parents reported no specific diets. According to the study by Nisar et al. (2022), for some diagnoses in individuals with autism spectrum disorder (ASD) aged five and over, a casein- and gluten-free diet is necessary because they cannot properly digest protein, especially casein and gluten. Therefore, in their daily diet, autistic children need to avoid foods containing both

gluten and casein. Negative impacts if autistic children continue to consume gluten and casein include bloating and stomach upset. This discomfort can ultimately lead to tantrums. However, implementing a GFCF diet requires a proper understanding to avoid certain nutrient deficiencies. Restricting gluten- and casein-containing foods without proper planning can reduce energy, protein, calcium, and vitamin D intake in autistic children. Support from healthcare professionals, particularly nutritionists, is essential in planning and evaluating this special diet. With proper supervision, the GFCF diet is expected to help reduce digestive and behavioral disorders without compromising the nutritional adequacy of autistic children (Elshamy et al., 2025).

Likes Vegetables and Fish

Table 2 shows that most children prefer vegetables (61.6%) and fish (81.25%). These results were obtained through interviews and the review of FFQ results and were confirmed with parents or caregivers. Some children dislike vegetables and fish because their parents rarely serve them. As a result, autistic children tend to have difficulty accepting new foods they are not accustomed to (Esposito et al., 2023). The most consumed vegetable by children is spinach. Spinach contains a wide variety of micronutrients, including flavonoids. Flavonoids, as antioxidants, can help protect the body against free radicals, thereby reducing inflammation and the severity of autism symptoms in children. In addition to flavonoids, spinach contains important vitamins and minerals that support nervous system health and function. Regular vegetable consumption can help improve micronutrient intake in autistic children. However, reliance on a single type of vegetable indicates a lack of variety in vegetable consumption. Strategies are needed to gradually introduce additional vegetables so that autistic children can consume a wider variety and obtain optimal nutritional benefits (Tsujiguchi et al., 2022).

The number of autistic children in the Greater Jakarta area who enjoy fish dishes is also higher than that of those who do not. The results of the FFQ interview showed that most autistic children consumed catfish more often than other types of fish. The high protein content in catfish can help boost the immune system and replace damaged cell tissue (El-Houseiny et al., 2023). Omega-3 is beneficial for the development of the brain and other organs, both morphologically, biochemically, and molecularly. Omega-3 deficiency in children can impact brain development, physical health, and social interactions. The omega-3, omega-6, and omega-9 found in catfish are a good combination for improving cognitive and visual abilities in children. Based on in-depth interviews, information was obtained that, besides catfish, other popular fish include tilapia and mujair. The preference of autistic children for freshwater fish such as catfish, tilapia, and mujair is thought to be related to their milder flavor and softer texture, which makes them more readily accepted. Furthermore, these fish are relatively readily available in the Greater Jakarta area at affordable prices. Regular fish consumption significantly contributes to meeting the protein and essential fatty acid intake of autistic children. Increasing the variety of fish dishes by using appropriate processing techniques should be encouraged to optimize and sustain nutrient intake from fish (Roziana & Humaroh, 2025).

The overall macronutrient intake of autistic children in the Greater Jakarta area falls into the insufficient category, or <80% of the RDA (Table 3). Interview results using a 2x24-hour food recall questionnaire indicate that the average autistic child has a good eating pattern, namely 2-3 main meals. This lack of macronutrient intake in autistic children is more related to the amount or portion per serving that is still below the child's daily needs. Macronutrients are essential for providing the body with energy. A deficiency in macronutrients can interfere with children's growth and development. Energy deficiency will impair brain function and development, as well as

cognitive development and growth. If children lack protein, they will grow more slowly (Taraghijah, 2024). Fat intake is also essential for children's growth because it contains essential fatty acids, which are important for maintaining health. Furthermore, a lack of carbohydrate intake also affects a child's brain growth and development, as carbohydrates serve as a primary energy source for the body. Therefore, a balanced intake of carbohydrates, protein, and fat is essential in the diet of autistic children. Adequate macronutrient intake will support the child's metabolism, organ function, and daily activities. Long-term, unbalanced diets can increase the risk of nutritional disorders and worsen a child's development. Therefore, appropriate and varied menu planning is essential to ensure that the macronutrient needs of autistic children are met (Roziana & Humaroh, 2025).

In addition to considering food type and nutritional content, children with special needs also need to consider their acceptance of food texture. In-depth interviews with 10 respondents revealed that children with special needs dislike papaya and bananas because their textures are too soft. When given food that is too soft, they vomit. Some children prefer crunchy textures, such as broccoli or snake fruit. This preference for food texture is not simply a matter of ordinary picky eating behavior, but rather a manifestation of Sensory Over-responsivity (SOR). This aligns with the Sensory Integration theory, which states that sensory input (texture, smell, color) is processed differently in the brains of children with autism (Oliveira & Souza, 2022). The predominance of crunchy textures and the rejection of vegetables (soft/mucous textures) indicate a deficit in the oral tactile system. This condition tends to limit the types of foods acceptable to autistic children, potentially reducing the variety of nutritional intake. Rejection of certain textures can pose challenges for parents in meeting children's nutritional needs in a balanced way. Therefore, feeding strategies tailored to the child's sensory profile are needed, such as gradual texture modification and oral desensitization techniques. This approach is expected to increase children's tolerance to various food textures and support nutritional adequacy and overall diet quality.

CONCLUSION

Children with Autism Spectrum Disorder (ASD) in the Greater Jakarta area show a high preference for freshwater fish and spinach, but this is not yet accompanied by optimal nutritional intake. General macronutrient deficiencies (<80% of the RDA) are associated with limited food variety and serving sizes that remain insufficient to meet children's daily needs. Adoption of a gluten-free and casein-free (GFCF) diet is also relatively low, primarily because parents lack knowledge of gluten and casein sources, particularly in commercially processed foods. Furthermore, sensory over responsiveness to food texture is a significant barrier to the acceptance of new foods, limiting the diversity of nutrients consumed. The dietary patterns of autistic children in the Greater Jakarta area still require adjustments and more targeted interventions to support optimal physical growth and cognitive development.

A sustainable nutrition education program is recommended for parents and caregivers, with a particular focus on reading food labels and on texture modification techniques to address children's sensory challenges. Support from a nutritionist is essential for developing menu plans that not only adhere to GFCF principles but also ensure adequate macronutrient density. Furthermore, the use of freshwater fish and spinach, which children already enjoy, can be optimized as basic ingredients in various forms, as well as in processed foods, to increase omega-3 and antioxidant intake without triggering sensory rejection.

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CONFLICT OF INTEREST

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