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Research Article

ADVANCES IN FOOD ALLERGY PREVENTION AND MANAGEMENT: THE ROLE OF NUTRITION AND DIETARY MODULATION

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ABSTRACT

Food allergies have become a major public health concern, affecting individuals across all age groups and contributing to increased morbidity, healthcare burden, and reduced quality of life. Recent advances in nutritional science and immunology have reshaped the understanding of allergen exposure, immune tolerance, and dietary modulation. This review synthesizes current evidence on nutritional factors influencing food allergy development, prevention, and long-term management. Emphasis is placed on early-life feeding practices, role of breastmilk bioactive components, controlled allergen introduction, microbiome-supportive diets, and nutritional interventions that reduce inflammatory responses. Additionally, therapeutic diets and emerging approaches such as precision nutrition and probiotic-based modulation are discussed. The findings highlight that nutrition-centered strategies can significantly lower the risk of sensitization and support immune tolerance, underscoring the need for integrated clinical and dietary practices for effective food allergy prevention and management.

Keywords: Food allergy, Nutritional modulation, Immunotolerance, Early allergen introduction, Microbiome.

INTRODUCTION

Food allergies represent an abnormal immunological reaction to food proteins mediated by IgE or non-IgE pathways. The global prevalence has increased significantly, with estimates ranging from 6–8% in children and 3–4% in adults. Factors contributing to this rise include genetic predisposition, environmental influences, gut microbiome alterations, and dietary patterns Mazzocchi, *et al*. (2017). Nutritional science has emerged as a crucial discipline in understanding food allergy etiology Zhang, *et al*. (2023). Studies now show that early dietary exposures, nutrient deficiencies (such as vitamin D), and gut microbiota composition are pivotal determinants in immune tolerance and sensitization Sampath *et al*. (2025); Allen, K & Koplin, (2023). Traditional management strategies such as strict allergen avoidance have shifted toward proactive tolerance induction through controlled dietary exposure. This paper reviews key nutritional strategies and their scientific rationale in food allergy prevention and management, emphasizing emerging evidence-based dietary approaches and clinical implications. Research demonstrates that early introduction of allergenic foods, particularly peanut, cow's milk, and egg, in infancy decreases the risk of developing allergies to these foods. Landmark studies and meta-analyses confirm that more regular and age-appropriate introduction (rather than strict avoidance) is a crucial preventive strategy. The prevention benefit depends not just on early exposure, but also on regular and continued ingestion. Studies such as the LEAP and PETIT trials, along with subsequent population-level studies, suggest that ongoing consumption of the introduced allergen (e.g., peanuts weekly) is necessary for sustaining desensitization and tolerance. For certain foods like eggs, the form in which an allergen is introduced can

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influence allergenicity and effectiveness. Heated or cooked forms are recommended for weaning infants, as they reduce allergenic potential and are better tolerated during early introductions.

Research supports that greater diet diversity during weaning lowers the overall risk of food allergy. Introducing a range of foods, rather than a limited set, is associated with better immune system development and a lower risk of multiple allergies. Studies reveal that nutritional interventions, including the use of probiotics, prebiotics, and specific nutrients (e.g., vitamin D), can modulate immune responses and may help in the primary prevention of allergies. However, evidence remains mixed, and ongoing trials are further clarifying their role. Maternal nutrition during pregnancy and breastfeeding, especially intake of certain nutrients or exposure to allergenic foods, may influence the child's future risk of food allergy, though findings here are nuanced and context-specific. Screening infants for allergy risk before food introduction is generally not recommended, as widespread testing can increase anxiety and result in unnecessary avoidance. Instead, strategic, evidence-based advice for families is critical for successful implementation.

MATERIALS AND METHODS

Data Extraction Relevant findings were categorized into: Early nutrition and prevention, Dietary factors influencing immune tolerance, Microbiome-related modulation, Therapeutic diets and clinical management.

RESULTS AND DISCUSSION

Early Life Nutrition and Allergy Prevention Breastfeeding Breastmilk contains immunomodulatory components such as: Secretory IgA, Human milk oligosaccharides (HMOs), Anti-inflammatory cytokines. These compounds promote gut barrier integrity and shape immune tolerance, reducing early sensitization risk. Landmark studies (LEAP, EAT trials) show that early introduction of peanut and egg (at 4-6 months) reduces subsequent allergy by up to 70–80% Osborn, DA., *et al*. (2022). Nutritional Modulation of the Gut Microbiome, the gut microbiota plays a central role in educating the immune system. Foods that enhance beneficial microbiota: High-fiber foods, Fermented foods (yogurt, kefir), Prebiotic-rich foods. Studies show that *Lactobacillus rhamnosus* GG and Bifidobacterium species reduce eczema and food allergy risk by modulating mucosal immunity Boyce *et al*. (2021); Fox *et al*. (2024). Low serum vitamin D levels correlate with peanut and milk allergy. Vitamin D supports epithelial barrier integrity and T-regulatory cell function. They shift immune response from Th2-dominant (allergic) to a more balanced profile. Antioxidants Vitamins C, E, and polyphenols reduce oxidative stress and inflammation associated with food allergies. Dietary Management in Diagnosed Food Allergy (Caffarelli *et al*. (2022). Oral Immunotherapy (OIT). Controlled exposure to allergens (e.g., peanut protein) promotes gradual desensitization.

CONCLUSION

Nutrition plays a central role in both the prevention and management of food allergies. Evidence strongly supports early controlled exposure, gut microbiome modulation, and nutrient optimization for reducing allergic sensitization. For diagnosed individuals, diet-based therapy, combined with emerging immunotherapy approaches, offers improved outcomes and quality of life. Integrating nutritional strategies with clinical practice provides a holistic approach to managing food allergies. Development of precision-nutrition models using genetic, microbial, and metabolic signatures. Longitudinal studies on the impact of early feeding practices on lifetime allergy risk. Advanced probiotic and postbiotic formulations specifically designed to promote immune tolerance. Personalized oral immunotherapy protocols with multicenter trials. Integration of digital diet tracking and AI-based allergy prediction tools in clinical care.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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