

Milk Allergy: A Comprehensive Review

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Abstract: *Milk allergy is an adverse immune response to milk proteins, predominantly affecting children under four years of age. It is estimated to affect approximately 2–3% of children under three years old (Vandenplas et al., 2024). It's crucial to differentiate between milk allergy and lactose intolerance. While lactose intolerance results from a deficiency of the enzyme lactase, leading to digestive issues, milk allergy involves an immune response to proteins such as casein and whey (Walsh et al., 2016).*

This review delves into the immune mechanisms behind milk allergy, explores case studies, examines genetic and environmental factors influencing the condition, and discusses dietary alternatives. Additionally, it addresses complications arising from dairy avoidance and analyzes the impact on the quality of life for individuals diagnosed with milk allergy.

Keywords: Milk allergy; Cow's milk protein allergy (CMPA); Lactose intolerance; Casein allergy; Whey protein hypersensitivity; IgE-mediated allergy

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1. Introduction

For many, milk represents the first source of nourishment—rich in essential proteins, calcium, and vital nutrients that support growth and development. Yet, for a notable group of infants and young children, this seemingly harmless food becomes a trigger for distressing and sometimes dangerous immune reactions [1].

Cow's milk protein allergy (CMPA) arises when the immune system mistakenly targets milk proteins—casein, β -lactoglobulin, and α -lactalbumin—as threats [2]. Unlike lactose intolerance, which stems from lactase deficiency, CMPA is immunologically driven, manifesting in either IgE-mediated acute reactions or non-IgE-mediated chronic symptoms [3].

Recent research suggests that perinatal influences such as cesarean delivery, maternal antibiotic use, or early cessation of breastfeeding can play a role in sensitizing infants to milk proteins [4, 5].

2. Materials and Methods

Study Design

This review used literature from PubMed Central, Mayo Clinic, and the National Digital

Library, including case studies and original research.

Data Sources

- Primary: Mayo Clinic, National Digital Library, PubMed Central
- Secondary: Directory of Open Access Journals, relevant peer-reviewed research

Selection Criteria

Only human studies related to milk allergy, especially in children, were considered. Studies on perinatal influences and clinical interventions were prioritized.

3. Results and Discussion

Immune Response to Milk Allergy

Milk allergy involves a Type I hypersensitivity reaction, where IgE antibodies trigger immune responses to proteins like casein, beta-lactoglobulin, and alpha-lactalbumin [2]. Symptoms include wheezing, vomiting, hives, and in severe cases, anaphylaxis [6].

While most affected children outgrow the allergy by age 3–5, about 20% continue to be allergic into adolescence [4].

Diagnosis

Accurate diagnosis combines clinical history with tests like skin prick testing, serum-specific IgE, and oral food challenges [4]. A Bahrain study showed IgE-mediated allergies require prolonged monitoring, especially when breastfeeding is replaced early with cow's milk [7].

Case Studies

- Preterm Infant with Ascites: Managed with breast and donor milk, emphasizing the protective effect of human milk [1].
- Children with Diarrhea: About 3% of such cases were traced back to cow's milk allergy [4].
- Infant with Generalized Flushing: A 2-month-old developed allergic flushing upon being given cow's milk-based formula, underscoring the need for careful formula introduction [5].

3.1 Perinatal Factors and Milk Allergy

Research has linked early-life factors like antibiotics during pregnancy and short breastfeeding duration to milk protein sensitization [2]. However, evidence remains inconclusive and further trials are needed.

Alternatives to Milk

Dietary substitutes such as oat, almond, soy, rice, and coconut milk offer allergen-free

nutrition. However, nutritional profiles vary and must be carefully selected [3].

Extensively hydrolyzed and amino acid-based formulas are preferred in clinical cases [4]. Opinions on using probiotics and prebiotics differ by region [8].

3.2 Baked Milk Oral Immunotherapy (BMOIT)

BMOIT has shown promise in desensitizing allergic children. A 2025 clinical trial found 70% of participants reached the endpoint with reduced allergic reactions [9].

Serology-A Diagnostic Tool

Elevated IgE levels in blood can confirm sensitization [2]. In severe reactions like anaphylaxis, immediate intervention with epinephrine is lifesaving [1].

Complications

Chronic dairy avoidance can lead to calcium, vitamin D, and protein deficiencies. This can affect bone density and child growth, along with psychological impacts due to dietary restrictions [3]. Nutritional yeast, tofu, soy protein, and supplements can help bridge these gaps.

4. Conclusion

Milk allergy is a serious and multifaceted condition requiring clinical attention, dietary

modifications, and long-term monitoring. Differentiating it from lactose intolerance is vital for accurate treatment. Further research on perinatal factors and immunotherapy strategies can enhance outcomes for affected individuals.

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