



The Association Between Peanut Allergies and Vitamin D Levels: Evidence and Contradictions

Peanut allergies have increased dramatically in Western countries over recent decades, coinciding with a decline in vitamin D levels in the general population. This correlation has prompted researchers to investigate whether vitamin D insufficiency or deficiency might play a role in the development of peanut and other food allergies. Current research reveals a complex relationship that is not fully understood, with some studies supporting an association while others show mixed or contradictory results.

Evidence Supporting an Association

Several studies have identified significant correlations between low vitamin D levels and increased risk of peanut allergy. In a population sample of one-year-old infants, those with vitamin D insufficiency (≤ 50 nmol/L) were approximately 11 times more likely to have peanut allergies compared to infants with adequate vitamin D concentrations^[1]. This association was particularly strong among children of Australian-born parents, suggesting potential genetic or environmental interactions^[1].

A systematic review found that children with vitamin D insufficiency were almost twice as likely to have peanut sensitization (OR: 1.96, 95% CI [1.08-3.57])^[2]. This finding aligns with observations that regions further from the equator, which receive less ultraviolet radiation and consequently have populations with lower vitamin D synthesis, show higher rates of peanut allergy-up to six times the risk compared to areas closer to the equator^[3].

Additionally, vitamin D insufficiency appears to increase the risk of developing multiple food allergies rather than just a single food allergy. Children with vitamin D insufficiency were more than 10 times more likely to have multiple food allergies (≥ 2) compared to those with adequate vitamin D levels^[1] ^[4].

Geographic and Demographic Patterns

The relationship between vitamin D status and peanut allergy shows interesting geographic and demographic patterns. Studies have observed that areas further from the equator have higher rates of:

- Childhood food allergy-related hospital admissions
- Epinephrine autoinjector prescriptions
- Peanut allergy prevalence^[3]

Intriguingly, the association between vitamin D insufficiency and peanut allergy was primarily observed in children of Australian-born parents, rather than those who had migrated to Australia^[5] ^[1]. This finding suggests that genetic factors, environmental exposures, or some

interaction between the two may influence the relationship between vitamin D and peanut allergy risk.

Contradictory Findings and Complex Relationships

Despite evidence supporting an association, not all research demonstrates a straightforward relationship between vitamin D levels and peanut allergy. Some studies suggest the relationship may be nonlinear or more complex than initially thought:

Nonlinear Relationship

A study by Mullins et al. found that the relationship between neonatal 25(OH)D levels and childhood peanut allergy was nonlinear^[6]. Specifically, slightly higher levels (75–99.9 nmol/L) were associated with lower risk of peanut allergy compared to the reference group (50–74.9 nmol/L), but no further reduction in risk was observed at levels ≥ 100 nmol/L^[6]. This suggests that the relationship between vitamin D and peanut allergy may not be a simple "more is better" scenario.

Lack of Association in Some Studies

A systematic review and meta-analysis examining the association between vitamin D status and food allergy did not identify a significant association in children (odds ratio 1.35, 95% CI 0.79–2.29)^[7]. When analyzing studies using a cutoff of <20 ng/mL versus ≥ 20 ng/mL for vitamin D insufficiency, they found no significant differences (OR 1.18, 95% CI 0.62–2.27)^[7]. The review concluded that more research is needed to establish a clear relationship.

Sunlight Exposure vs. Vitamin D Supplementation

An important distinction emerges from the research between vitamin D obtained through sunlight exposure versus supplementation:

Many studies have linked sunlight exposure with food allergy development, but whether this directly relates to vitamin D status or other sunlight-derived factors remains uncertain^[8]. Some research suggests that sunlight exposure in early life may protect against allergies through mechanisms that may be independent of vitamin D status.

An Australian study found that infants who received sufficient sunlight in the first three months of life had lower levels of laboratory markers indicative of allergies and were less likely to develop eczema than those with less sun exposure^[9]. Interestingly, the same study found that supplemental vitamin D had no influence on the development of allergies or eczema, suggesting that sunlight might confer protection through additional pathways beyond vitamin D production^[9].

Potential Mechanisms

Several biological mechanisms may explain how vitamin D could influence peanut allergy development:

1. **Intestinal Barrier Integrity:** Vitamin D appears to maintain the integrity of the mucosal barrier, preventing the intestinal immune system from being exposed to food allergens and reducing intestinal permeability^[10]. Low vitamin D levels may lead to intestinal damage that allows food proteins to penetrate the immune system, stimulating IgE production and allergic responses^[10].
2. **Immune System Modulation:** Vitamin D plays an essential role in immune system function, potentially influencing the balance between allergic (Th2) and non-allergic immune responses^{[3] [5]}.
3. **Skin Barrier Function:** The "dual allergen exposure" hypothesis suggests that food allergy may develop when food proteins penetrate a disrupted skin barrier during early life^[10]. Vitamin D deficiency might contribute to impaired skin barrier function, increasing the risk of allergic sensitization.

Conclusion and Future Directions

The current evidence suggests that vitamin D status may influence the risk of developing peanut allergies, but the relationship is complex and likely influenced by genetic, environmental, and demographic factors. While many studies support an association between low vitamin D levels and increased risk of peanut allergy, others show mixed or contradictory results.

Further research is needed to:

1. Establish standardized definitions of vitamin D deficiency and insufficiency
2. Determine the optimal vitamin D status needed to support immune function and prevent allergies
3. Clarify whether vitamin D supplementation can effectively prevent or reduce peanut allergy risk
4. Understand the differential effects of sunlight exposure versus vitamin D supplementation
5. Explore potential gene-environment interactions that may modify this relationship^{[7] [11]}

As one research team concluded: "Vitamin D must be considered as a further chance in comprehension and treatment of atopic diseases. There is an urgent need for well-planned randomized controlled trials on vitamin D supplementation in food allergy"^[4].

While the research comparing vitamin D deficiencies to food allergies is not fully conclusive, understanding this relationship may provide important insights for prevention and treatment strategies for peanut and other food allergies in the future.

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1. <https://pubmed.ncbi.nlm.nih.gov/23453797/>

2. <https://pubmed.ncbi.nlm.nih.gov/36790484/>

3. <https://www.aaaai.org/tools-for-the-public/conditions-library/allergies/vitamin-d-food-allergy>
4. <https://pmc.ncbi.nlm.nih.gov/articles/PMC7461773/>
5. <https://pmc.ncbi.nlm.nih.gov/articles/PMC6010899/>
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8. <https://sunlightinstitute.org/sunlight-food-allergies/>
9. <https://www.ecarf.org/en/vitamin-d-does-not-protect-infants-from-allergies/>
10. <https://pmc.ncbi.nlm.nih.gov/articles/PMC8578786/>
11. <https://www.jaxallergy.com/vitamin-d-deficiency-food-allergies/>