

Feeding the skin: The emerging role of nutritional intervention in dermatological disorders

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Chronic skin diseases impose a growing clinical burden often incompletely addressed by pharmacotherapy alone due to cumulative adverse effects and metabolic comorbidities. Nutrition represents a critical, modifiable environmental determinant capable of altering disease trajectories through the gut-skin axis and systemic immune homeostasis. In this commentary, we synthesize recent epidemiological data, international guidelines, and high-quality trials to map specific dietary risks, targeted therapeutic interventions, and clinical pitfalls across common dermatological conditions (Table 1). We posit that while diet is rarely curative as monotherapy, transitioning from associative epidemiology and empirical supplementation to precision nutrition is an essential evolution, empowering clinicians to optimize patient outcomes and advance holistic dermatologic care.

SKIN DISORDERS

Acne vulgaris is heavily influenced by dietary behaviors. The NutriNet-Santé cohort (2020) revealed that frequent consumption of sugary products and milk significantly increases acne risk.¹ Mechanistically, high glycemic index (GI) foods and dairy products drive hyperinsulinemia and elevate insulin-like growth factor-1 (IGF-1), promoting sebocyte proliferation and lipogenesis via the PI3K/Akt/mTORC1 signaling pathway. Clinically, specific randomized controlled trials (RCTs) cited in the 2024 American Academy of Dermatology (AAD) guidelines observed that low-GI diets could reduce total lesion counts compared to controls. However, guidelines emphasize that current evidence remains "insufficient" for broad recommendations due to trial heterogeneity, highlighting a key gap in clinical translation. Thus, while emerging supplements like omega-3 fatty acids and probiotics show mechanistic promise in dampening inflammation, they warrant rigorous validation before integration into standard care.

Atopic dermatitis (AD) is driven primarily by T helper 2 (Th2)-dominant immune dysregulation. Regarding dietary risk, a 2024 large-scale cross-sectional study identified high sodium intake as a significant risk factor. As for intervention, the 2022 European guidelines discourage indiscriminate elimination diets without confirmed sensitization and routine nutritional supplements for treatment, while noting insufficient evidence to support probiotics. However, emerging high-quality evidence suggests a shift: a 2024 meta-analysis confirmed that vitamin D supplementation significantly reduces AD severity by enhancing skin barrier function.² Similarly, a 2024 task force report from the European Academy of Allergy and Clinical Immunology (EAACI) demonstrated that probiotic interventions significantly reduce SCORing Atopic Dermatitis (SCORAD) scores. While current guidelines remain conservative, these findings highlight the gut-skin axis as a priority for future translational research.

Psoriasis is a systemic inflammatory disease inextricably linked to metabolic syndrome. A 2025 large-scale cross-sectional study linked high intake of ultra-processed foods with active psoriasis. Crucially, obesity attenuates the efficacy of biologics by altering pharmacokinetics, leading to relative underdosing and reduced drug survival.³ Consequently, hypocaloric diets are essential to restore therapeutic responsiveness. Regarding specific nutrients, the 2021 Joint AAD-National Psoriasis Foundation (NPF) guidelines suggest that oral omega-3 fatty acids could be useful as an adjunctive therapy to augment systemic treatments, potentially by downregulating Th17 pathways. Conversely, the guidelines do not recommend oral vitamin D—since safe doses that avoid hypercalcemia and calciuria fail to achieve

therapeutically effective local concentrations, unlike systemic immune modulation in AD. Furthermore, gluten-free diets are inadvisable without diagnosed celiac disease. Future research must prioritize large-scale RCTs given the inconsistent efficacy of single-nutrient supplementation in existing trials.

Vitiligo is an acquired depigmenting disorder. While specific dietary risk factors are less established than in other dermatoses, the pathogenesis is intrinsically driven by autoimmune and oxidative stress mechanisms. Regarding management, the 2023 International Vitiligo Task Force (IVTF) recommendations state that there is currently "little or no consensus" for most systemic antioxidants (e.g., vitamin E, C) due to methodological limitations. However, the guidelines acknowledge that oral antioxidants like *Polypodium leucotomos* and *Ginkgo biloba*, when combined with phototherapy, present "some evidence" for repigmentation.⁴ Notably, in patients with documented deficiencies, vitamin D supplementation is frequently considered an adjunctive therapy, though robust quantitative data on repigmentation efficacy remain inconsistent. Validating these adjunctive strategies requires standardized protocols to overcome current heterogeneity.

Alopecia, including alopecia areata (AA) and androgenetic alopecia (AGA), is increasingly recognized to correlate with nutritional status. A 2024 meta-analysis revealed that vitamin D deficiency (VDD) is a significant risk factor for patients with AA and female pattern hair loss (FPHL). Therapeutically, guidelines advise against empirical supplementation. Instead, clinical management should prioritize correcting specific deficits (e.g., ferritin, zinc, protein). Beyond deficiency correction, a recent comprehensive systematic review highlighted the emerging potential of pumpkin seed oil, zinc, and antioxidants (e.g., selenium, carotenoids, and vitamins A, C, and E). However, as noted in the review, excessive supplementation must be avoided as it may exacerbate hair loss and lead to toxic effects. Furthermore, future research must prioritize large-scale RCTs with active comparators to validate these nutraceutical strategies against standard pharmacotherapy.

Skin cancers and precancerous lesions pose a massive global burden. Meta-analyses and large cohorts identify significant modifiable dietary triggers including alcohol (increasing the risk of both melanoma and non-melanoma skin cancers [NMSCs]) and high citrus intake (elevating melanoma risk). For chemoprevention, 2020 British and 2023 European guidelines suggest that oral nicotinamide could be considered in immunocompetent patients with multiple prior NMSCs to reduce new lesions. Crucially, guidelines note this clinical benefit does not extend to actinic keratosis or immunosuppressed solid-organ transplant recipients and explicitly recommend against routine antioxidant supplements due to unproven efficacy. Beyond primary prevention, the gut-skin axis represents a critical frontier in advanced melanoma. Recent landmark studies demonstrate that high-fiber diets, probiotics and Mediterranean dietary patterns favorably modulate the gut microbiome, significantly improving overall response rates and progression-free survival in patients receiving immune checkpoint blockade (ICB).⁵ This highlights a profound diet-immune synergism, positioning precision nutrition as a pivotal adjunct in dermatologic oncology.

CONCLUSIONS AND FUTURE DIRECTIONS

Although mechanisms like gut-skin modulation underscore nutrition's dermatological importance, current evidence remains Western-centric, necessitating localized studies across diverse ethno-cultural populations. We propose an integrative agenda encompassing: multicenter RCTs with stan-

Table 1. Overview of nutritional epidemiology, pathophysiology, guideline status, dietary risk and interventions for common dermatological conditions.

Dermatosis	Global Prevalence	Pathophysiological Mechanisms	Guideline Status	Dietary Risk & Interventions (Quantitative Effect) – Study Design
Acne Vulgaris	>9% (Global).	Hyperinsulinemia and elevated IGF-1 drive sebocyte proliferation/lipogenesis via PI3K/Akt/mTORC1.	2024 AAD guidelines Elimination: Specific restriction not universally mandated. Supplements: Insufficient data for formal recommendation.	Risk: High-GI foods (aOR: 1.54) and dairy intake (aOR: 1.12) – Large prospective cohort. ¹ Interventions: Low-GI diets (SMD: -8.1 to not significant) – Inconsistent RCTs. Omega-3 fatty acids and probiotics – Small/inconsistent RCTs.
Atopic Dermatitis	Up to 20% (Children); 10% (Adults).	Th2-dominant immune dysregulation; Skin barrier defects.	2022 European guideline Elimination: Avoid blind dietary elimination to prevent flares unless clinical allergies are confirmed. Supplements: No routine recommendation.	Risk: High dietary sodium intake (aOR: 1.11 per 1g increase in daily sodium excretion) – Cross-sectional study. Interventions: Vitamin D: Reduces severity in deficient patients (SMD: -0.41) – Meta-analysis of RCTs. ² Probiotics: Reduces SCORAD (MD: 5.54) – Meta-analysis of RCTs.
Psoriasis	0.14% (East Asia) to 1.99% (Australasia).	Systemic inflammation linked to metabolic syndrome; Th17 pathway activation.	2021 Joint AAD-NPF guidelines Elimination: Gluten-free is inadvisable unless celiac disease is confirmed. Supplements: Omega-3: Adjunctive to augment systemic treatments; Oral Vitamin D: Not recommended.	Risk: High ultra-processed food intake (aOR: 1.36) – Cross-sectional study. BMI $\geq$ 30 reduces biologic efficacy (PASI 90 OR: 0.57) – Meta-analysis. Interventions: Hypocaloric diets for obese patients: Increases likelihood of achieving PASI 75 (RR: 1.66) – Cochrane systematic review. Omega-3 Fatty Acids: Could augment treatment efficacy (adjuvant) – Guidelines.
Vitiligo	0.5–2%.	Autoimmune destruction of melanocytes; Oxidative or stress.	2023 IVTF Supplements: Antioxidants: Little or no consensus; <i>Ginkgo biloba</i> or <i>Polypodium leucotomos</i> + phototherapy: may be beneficial.	Risk: No specific dietary risk factors currently established. Interventions: Antioxidants + Phototherapy (RR: 1.87) – Meta-analysis of RCTs. ⁴ Vitamin D (mono/adjuvant) – Inconsistent cohorts/RCTs.
Alopecia	AA: ~2%. AGA: Age-dependent (up to 80% men / 50% women).	AA: Associated with VDD; AGA: Androgen sensitivity (5-AR activity).	2018/2024 EADV guidelines Supplements: No routine recommendation; Avoid biotin (Vitamin B7) supplementation in AA unless deficiency is confirmed.	Risk: VDD in FPHL (OR 5.24) and AA (OR 2.84) – Meta-analysis. Interventions: Pumpkin seed oil/Zinc/Antioxidants (potential benefit); Treat only diagnosed deficiencies to avoid toxicity – Systematic review of small RCTs.
Skin Cancers & Precancerous Lesions	Cutaneous melanoma: ~1.7% of all incident cancers globally. AK: >14% globally.	Ultraviolet radiation; Accumulation of genetic mutations; Immune evasion or immunosuppression; Tumor microenvironment interactions.	2020 British guidelines of cSCC 2023 European guideline of BCC 2024 European guideline of AK Supplements: Nicotinamide (Vitamin B3): 500 mg twice daily for chemoprevention in immunocompetent NMSC patients. Not Recommended: Selenium, Vitamin A, and beta-carotene for BCC; Any routine nutritional chemoprevention for AK.	Risk: Alcohol: Increases both NMSCs (BCC RR: 1.07, cSCC RR: 1.11) and melanoma risk (RR: 1.20) – Meta-analyses (no association with AK). Citrus: High intake increases melanoma risk (OR: 1.63) – Large prospective cohort. Interventions: Nicotinamide (Vitamin B3) 500 mg twice daily: Reduces new NMSCs (20–30% reduction) – Phase 3 RCT. Mediterranean diets, probiotics & high-fiber diets: Improves ORR and PFS-12 in melanoma ICB – Prospective cohorts. ⁵

Abbreviations: AA, Alopecia Areata; AAD, American Academy of Dermatology; AGA, Androgenetic Alopecia; AK, Actinic Keratosis; aOR, adjusted Odds Ratio; BCC, Basal Cell Carcinoma; BMI, Body Mass Index; cSCC, cutaneous Squamous Cell Carcinoma; EADV, European Academy of Dermatology and Venereology; FPHL, Female Pattern Hair Loss; GI, Glycemic Index; ICB, Immune Checkpoint Blockade; IGF-1, Insulin-like Growth Factor-1; IVTF, International Vitiligo Task Force; MD, Mean Difference; MPHL, Male Pattern Hair Loss; NMSCs, Non-Melanoma Skin Cancers; NPF, National Psoriasis Foundation; OR, Odds Ratio; ORR, Overall Response Rate; PASI, Psoriasis Area and Severity Index; PFS-12, Progression-Free Survival at 12 months; RCT, Randomized Controlled Trial; RR, Risk Ratio; SCORAD, SCORing Atopic Dermatitis; SMD, Standardized Mean Difference; Th, T helper cell; VDD, Vitamin D Deficiency; 5-AR, 5-alpha-reductase.

standardized outcomes to define optimal dosages; dermatology-specific screening tools; nutrition-integrated residency curricula; and multidisciplinary policy guidelines. Transitioning from associative epidemiology to targeted precision nutrition is paramount for optimizing long-term disease management.

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DECLARATION OF INTERESTS

The authors declare no competing interests.