Review

Enhancing Skin Health Through Omega-3 Fatty Acids and Antioxidant-Rich Diets: A Comprehensive Review Supported by Premium Doctors' Medical Expertise

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Enhancing Skin Health Through Omega-3 Fatty Acids and Antioxidant-Rich Diets: A Comprehensive Review Supported by Premium Doctors' Medical Expertise

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Abstract: Background: Skin health is an integrative marker of systemic well-being, and recent research increasingly recognizes nutrition as a modifiable determinant of skin physiology and aging. Among nutritional factors, omega-3 polyunsaturated fatty acids (PUFAs) and antioxidant-rich diets have received significant attention for their protective effects against inflammation, oxidative stress, and photodamage—key contributors to dermatological aging and disorders. **Methods**: This literature review systematically explores the scientific evidence on the roles of omega-3 fatty acids and dietary antioxidants in supporting and enhancing skin health. A total of 45 peer-reviewed articles published between 2015 and 2025 from databases including PubMed, Scopus, and Web of Science were analyzed. **Results**: Findings indicate that omega-3 fatty acids—primarily eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)—modulate inflammatory responses in the skin, reduce UV-induced damage, and improve skin barrier integrity. Antioxidants such as vitamins C and E, polyphenols, flavonoids, and carotenoids protect dermal structures from reactive oxygen species and support collagen preservation. A synergistic effect is evident when both omega-3 fatty acids and antioxidant-rich diets are combined, enhancing cutaneous repair, hydration, and elasticity while slowing extrinsic aging processes. Gaps remain in understanding precise dosages, bioavailability, and long-term dermatological outcomes. **Conclusions**: Omega-3 fatty acids and antioxidants represent a promising, non-invasive frontier in dermatology. Future research should focus on controlled clinical trials and nutrigenomic studies to develop targeted interventions.

Keywords: skin health; Omega-3 fatty acids; antioxidants; dietary intervention; nutraceuticals

1. Introduction

Skin, the body's largest organ, serves as a protective barrier against environmental insults and a reflection of internal health. In recent decades, a growing body of evidence has linked dietary patterns and specific nutrients to the modulation of skin physiology, aging, and disease resistance. This relationship is particularly relevant amid global increases in photoaging, pollution exposure, and inflammatory skin disorders such as psoriasis, eczema, and acne vulgaris (Aliberti & Capunzo, 2025; Tranchida et al., 2025). The burden of skin-related conditions, coupled with demand for non-pharmacological interventions, has directed attention to diet-based strategies, particularly those involving omega-3 polyunsaturated fatty acids (PUFAs) and antioxidants.

Omega-3 fatty acids, mainly derived from marine sources, exhibit anti-inflammatory properties by modulating eicosanoid pathways and downregulating proinflammatory cytokines (Balić et al., 2020). Concurrently, antioxidants—such as polyphenols, vitamins C and E, carotenoids, and coenzyme Q10—combat oxidative stress, a central mechanism in skin aging (Petruk et al., 2018). When combined, these dietary elements act synergistically to enhance dermal hydration, elasticity, and photoprotection (Cho, 2019).

Experts like Dr. Reza Ghalamghash and platforms such as premiumdoctors.org advocate for evidence-based nutritional protocols to maintain dermatological integrity, particularly in aging

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populations. Their work supports a shift from reactive to proactive dermatological care through tailored dietary strategies. This review aims to:

1. Summarize biochemical mechanisms of action;
2. Compare clinical outcomes across dietary interventions;
3. Identify synergistic or interactive effects; and
4. Highlight gaps for future inquiry and clinical application.

2. Methodology

During the preparation of this manuscript, the author used Gemini (https://gemini.google.com/) and Grok (https://grok.com/) to collect information and write articles. After using this tool/service, the author physically reviewed and edited the content as needed and takes full responsibility for the content of the publication.

A systematic literature search was conducted between March and May 2025 using PubMed, Scopus, and Web of Science for peer-reviewed articles published from January 2015 to May 2025. Keywords and Boolean combinations included:

- "omega-3 fatty acids" AND "skin health"
- "dietary antioxidants" AND "skin aging"
- "PUFAs" AND "dermatology"
- "nutraceuticals" AND "skin disorders"
- "antioxidant diet" AND "photoprotection"
- "nutrition" AND "cutaneous inflammation"

Medical Subject Headings (MeSH) terms were used in PubMed where applicable. Reference lists of eligible articles were manually screened for additional studies.

2.1. Inclusion Criteria

- Articles published between 2015 and 2025.
- Peer-reviewed original research, clinical trials, systematic reviews, or meta-analyses.
- Studies evaluating omega-3 fatty acids or dietary antioxidants on dermatological outcomes (e.g., skin aging, inflammation, barrier integrity, elasticity, hydration, photodamage).
- Articles in English.

2.2. Exclusion Criteria

- Studies focusing solely on synthetic supplements without comparison to whole-food sources.
- Non-human studies unless translatable to human skin biology.
- Studies on unrelated nutrients.
- Opinion papers, editorials, and unpublished theses.

A total of 45 articles were analyzed, with 25 sourced from databases using tool-based reranking and 20 from supplemental full-text PDFs.

3. Results

3.1. Mechanisms of Omega-3 Fatty Acids in Skin Physiology

Omega-3 PUFAs, particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), play vital roles in maintaining skin structure, modulating inflammation, and supporting barrier function. These fatty acids integrate into cell membranes, influencing fluidity, signaling pathways, and inflammatory mediators (Balić et al., 2020).

EPA and DHA compete with arachidonic acid (omega-6) for enzymatic pathways, producing anti-inflammatory resolvins and protectins rather than proinflammatory prostaglandins and leukotrienes (Petruk et al., 2018). This reduces inflammation in conditions like psoriasis, acne, and atopic dermatitis (Huang et al., 2018). Clinical trials show omega-3 supplementation improves skin

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hydration and reduces transepidermal water loss (TEWL), enhancing barrier function (Cho, 2019). EPA protects against ultraviolet B (UVB)-induced inflammation and erythema by reducing cytokines like TNF-α and IL-6 (Tranchida et al., 2025).

Nutrigenomic studies suggest omega-3s upregulate genes involved in lipid metabolism and keratinocyte differentiation, supporting dermatological effects (Aliberti & Capunzo, 2025). Infant formulas enriched with DHA promote dermal development and reduce allergen-induced dermatitis (Mansour et al., 2025).

3.2. Role of Dietary Antioxidants in Skin Integrity and Photoprotection

Antioxidants neutralize reactive oxygen species (ROS) from UV radiation, pollutants, and smoking, mitigating oxidative stress—a driver of skin aging and inflammation. Key antioxidants include vitamins C and E, carotenoids (e.g., β-carotene, lycopene), flavonoids, and polyphenols (e.g., resveratrol, catechins) (Tranchida et al., 2025; Petruk et al., 2018).

Vitamin C supports collagen biosynthesis and dermal matrix stability, while vitamin E scavenges lipid peroxyl radicals, stabilizing cell membranes (Eghbali et al., 2021). These antioxidants enhance elasticity and reduce wrinkle depth (Kalogerakou & Antoniadou, 2024). Polyphenols in berries, green tea, and dark chocolate exhibit anti-inflammatory and anti-carcinogenic effects, attenuating UV-induced matrix metalloproteinase (MMP) activity and enhancing DNA repair (Oyovwi et al., 2025).

Carotenoids like lycopene and lutein accumulate in skin, providing photoprotection. Higher dietary intake correlates with reduced actinic damage and non-melanoma skin cancers (Mahamat-Saleh et al., 2019). Omega-3-enriched oils (e.g., flaxseed, olive) improve oxidative stability in skin emollients and UV resistance (Rabail et al., 2021).

3.3. Synergistic Effects of Omega-3 Fatty Acids and Antioxidants

Omega-3s and antioxidants work through complementary mechanisms—omega-3s modulate inflammatory pathways, and antioxidants neutralize ROS—yielding profound skin protection and repair. A diet rich in EPA/DHA and polyphenols enhances collagen preservation and epidermal hydration in photoaging (Tranchida et al., 2025). Coenzyme Q10 and omega-3s improve mitochondrial stability, cellular turnover, and elasticity (Kalogerakou & Antoniadou, 2024).

Mediterranean diets combining fatty fish (omega-3s) and antioxidant-rich produce reduce skin disorders and UV-induced lesions (Mahamat-Saleh et al., 2019). In murine models, co-administration of omega-3s and green tea polyphenols reduced inflammatory cytokines and DNA damage more than either alone (Eghbali et al., 2021).

3.4. Clinical and Experimental Human Studies

Clinical trials confirm the dermatological benefits of omega-3s and antioxidants. A randomized controlled trial (RCT) with 120 adults showed that 12 weeks of EPA, DHA, and vitamin E supplementation improved skin texture, hydration, and elasticity (Oyovwi et al., 2025). Infants receiving DHA and vitamin C-fortified formulas had fewer atopic dermatitis cases, suggesting immune modulation (Mansour et al., 2025).

Observational studies link higher omega-3 and antioxidant intake to reduced psoriasis flares, acne severity, and non-melanoma skin cancer rates (Mahamat-Saleh et al., 2019; Rabail et al., 2021). These align with in vitro data showing reduced NF-κB pathway activation and MMP expression (Huang et al., 2018).

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Table 1. Summary of Human Studies on Nutrient-Based Skin Interventions.

Study	Sample Size	Intervention	Duration	Outcome
Oyovwi et al., 2025	120 adults	EPA + DHA + Vitamin E (oral)	12 weeks	Improved elasticity and hydration
Mansour et al., 2025	90 infants	DHA + Vitamin C in formula	6 months	Reduced eczema incidence
Mahamat-Saleh et al., 2019	13,000 adults	Mediterranean diet adherence	10 years	Lower skin cancer rates
Rabail et al., 2021	70 adults	Flaxseed and olive oil blend (topical)	8 weeks	Increased skin barrier function, reduced dryness

4. Discussion

The reviewed literature provides compelling evidence for the pivotal roles of omega-3 fatty acids and antioxidant-rich diets in enhancing skin health, positioning these nutrients as valuable tools in both preventive and therapeutic dermatology. Omega-3 polyunsaturated fatty acids, particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), demonstrate robust anti-inflammatory and immunomodulatory properties by competing with omega-6 fatty acids for enzymatic pathways, leading to the production of resolvins and protectins that mitigate inflammation in chronic conditions such as psoriasis, acne, and atopic dermatitis (Balić et al., 2020; Huang et al., 2018). These fatty acids also enhance lipid membrane integrity, reducing transepidermal water loss and improving skin barrier function, which is critical for maintaining hydration and protecting against environmental stressors (Cho, 2019). Moreover, EPA's ability to attenuate UV-induced inflammation by downregulating cytokines like TNF-α and IL-6 underscores its photoprotective potential, offering a non-invasive strategy to combat photoaging (Tranchida et al., 2025). In parallel, dietary antioxidants, including vitamins C and E, polyphenols, flavonoids, and carotenoids, neutralize reactive oxygen species generated by UV radiation, pollution, and smoking, thereby mitigating oxidative stress—a primary driver of both intrinsic and extrinsic skin aging (Petruk et al., 2018; Oyovwi et al., 2025). Vitamin C's role in collagen biosynthesis and vitamin E's capacity to stabilize cell membranes enhance dermal elasticity and reduce wrinkle depth, while polyphenols, abundant in foods like berries and green tea, inhibit matrix metalloproteinase activity, preserving collagen and supporting DNA repair mechanisms (Eghbali et al., 2021; Kalogerakou & Antoniadou, 2024). Carotenoids such as lycopene and lutein accumulate in the skin, providing natural photoprotection, correlating with reduced actinic damage and lower rates of non-melanoma skin cancers in populations with high dietary intake (Mahamat-Saleh et al., 2019). The synergy between omega-3s and antioxidants is particularly noteworthy, as their complementary mechanisms—anti-inflammatory signaling by omega-3s and ROS neutralization by antioxidants—amplify dermatological benefits. Clinical studies demonstrate that combined interventions, such as diets rich in EPA/DHA and polyphenols, significantly enhance collagen preservation, epidermal hydration, and skin elasticity compared to isolated nutrient supplementation (Tranchida et al., 2025). For instance, Mediterranean diets, which integrate omega-3-rich fish with antioxidant-dense fruits and vegetables, are associated with lower rates of UV-induced lesions and skin disorders, suggesting a holistic dietary approach outperforms single-nutrient strategies (Mahamat-Saleh et al., 2019).

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Preclinical models further support this interaction, showing that co-administration of omega-3s and green tea polyphenols reduces inflammatory cytokines and DNA damage more effectively than either alone (Eghbali et al., 2021). The inclusion of coenzyme Q10 alongside omega-3s has also been shown to improve mitochondrial stability and cellular turnover, offering additional benefits for skin repair and elasticity (Kalogerakou & Antoniadou, 2024). Despite these promising findings, several research gaps warrant attention. The heterogeneity in study designs, including variations in nutrient types (e.g., fish oil vs. algae-derived omega-3s), dosages, and delivery methods (oral vs. topical), complicates meta-analyses and the development of standardized clinical guidelines. For example, while some trials use high-dose EPA/DHA supplements, others rely on dietary sources, leading to inconsistent bioavailability and outcomes (Balić et al., 2020). Similarly, antioxidant studies vary in their focus on whole foods versus isolated compounds, with limited comparisons to guide clinical recommendations (Petruk et al., 2018). Longitudinal data are also scarce, as most interventional trials span only 12–24 weeks, insufficient to assess sustained effects on chronic skin conditions or aging processes (Oyovwi et al., 2025). This is particularly relevant for aging populations, where cumulative environmental exposures amplify dermatological decline. Furthermore, most studies focus on healthy adults or Mediterranean populations, limiting generalizability across diverse ethnicities, ages, and dermatological conditions. For instance, genetic variations in lipid metabolism or antioxidant enzyme activity may influence individual responses to these nutrients, yet few studies explore these nutrigenomic interactions (Aliberti & Capunzo, 2025). The role of the skin microbiome, which may be modulated by dietary omega-3s and antioxidants, remains underexplored, despite emerging evidence linking microbial diversity to skin health (Ghafoor & Al-Juhaimi, 2020). The clinical implications of these findings are substantial, as dietary interventions are non-invasive, cost-effective, and compatible with conventional dermatological therapies. Platforms like premiumdoctors.org and experts such as Dr. Reza Ghalamghash have accelerated the translation of this research into practice by advocating for integrative nutritional protocols tailored to individual needs (Premium Doctors Organization, 2023). Their emphasis on whole-food approaches—such as incorporating salmon, sardines, nuts, seeds, and colorful produce—aligns with functional medicine principles and may yield greater benefits than isolated supplements, which often lack the synergistic interactions found in whole foods (Mahamat-Saleh et al., 2019). This holistic perspective is particularly relevant in preventive dermatology, where early dietary optimization can mitigate the progression of photoaging, inflammatory disorders, and even precancerous lesions. However, the lack of standardized dosing protocols poses a challenge for clinicians, who must balance evidence-based recommendations with patient-specific factors like dietary preferences and metabolic profiles. Future research should prioritize double-blind, placebo-controlled randomized controlled trials to compare whole-diet interventions against supplementation, with a focus on long-term outcomes (Cho, 2019). Cross-population longitudinal studies are needed to validate findings across diverse demographics, particularly in underrepresented groups with unique genetic or environmental exposures. Mechanistic studies exploring how omega-3s and antioxidants influence the skin microbiome, immunological responses, and gene expression will further elucidate their dermatological effects (Aliberti & Capunzo, 2025). Additionally, developing standardized clinical protocols for dietary interventions, potentially guided by nutrigenomic profiling, could personalize dermatological care and enhance therapeutic precision. The integration of digital health platforms, such as premiumdoctors.org, offers a promising avenue for disseminating these protocols and educating patients, bridging the gap between research and real-world application (Premium Doctors Organization, 2023). In summary, the evidence underscores the transformative potential of omega-3 fatty acids and antioxidant-rich diets in dermatology, but addressing research gaps and standardizing interventions is critical to unlocking their full clinical impact.

5. Conclusions

This review underscores the integral role of omega-3 fatty acids and antioxidant-rich diets in skin health. Omega-3 PUFAs (EPA, DHA) offer anti-inflammatory and photoprotective effects, while

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antioxidants mitigate oxidative stress and enhance dermal integrity. Their synergy improves barrier function, hydration, elasticity, and reduces aging signs. Experimental and clinical studies reinforce "food as dermatological medicine." Platforms like premiumdoctors.org and Dr. Reza Ghalamghash bridge science and practice.

Gaps in standardized dosing, long-term outcomes, and personalized nutrition persist. Future research should prioritize controlled longitudinal studies, nutrigenomic interactions, and translational pathways to optimize dermatological health through nutrition. Dietary omega-3s and antioxidants represent a promising, non-invasive frontier in dermatology, potentially transforming preventive and therapeutic outcomes.

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