The Role of Diet in Preventing Photoaging and Treating Common Skin Conditions

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PRACTICE **POINTS**

- Growing evidence indicates that diet plays a role in overall skin health as well as the pathophysiology of several common cutaneous diseases.
- Broadly, we advocate for a low-glycemic diet that is rich in fruits and vegetables. In addition, dietary supplements of beta-carotene, collagen peptides, zinc, and fat-soluble vitamins (eg, vitamins D and E) have shown promising results in various conditions.

As interest in complementary and alternative medicine has grown, the relationship between diet and skin health has become an active area of research. Various supplements, plant derivatives, and antioxidants have gained attention as possible tools to prevent signs of aging and improve skin conditions. As such, knowledge of clinical trial data is important to counsel patients appropriately on risks and benefits of these complementary treatments and lifestyle modifications. Herein, we review the role of diet and supplements in preventing photoaging and treating common skin conditions.

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The connection between diet and physical beauty has been an area of increasing interest in popular culture as well as in the scientific community. Numerous supplements, plant derivatives, and antioxidants have been proposed to help improve skin conditions and prevent signs of aging.[1] Clinical and basic research has played an important role in confirming or debunking these claims, leading to new insight into oral supplements that may play a role in improving signs of photoaging, as well as symptoms of common skin diseases such as acne vulgaris (AV), atopic dermatitis (AD), and psoriasis. This article reviews some of the vitamins, supplements, and antioxidants that have been studied in the improvement of these conditions.

Photoaging

Recently, there has been increased interest among researchers in the role of antioxidants in combatting photoaging. The main determinants of photoaging are chronic sunlight exposure and melanin density. Photoaging presentation includes deep rhytides, pigmentary changes, dryness, loss of skin tone, leathery appearance, and actinic purpura.[2-4]

Beta-carotene is a fat-soluble derivative of vitamin A, which has retinol activity and has an inhibitory effect on free radicals. It has been used to decrease the effect of UV light on the skin as well as to treat erythropoietic porphyria.[5-7] One study evaluated the efficacy of low-dose and high-dose beta-carotene in improving facial rhytides and elasticity in a cohort of 30 women older than 50 years.[8] Participants were given 30 or 90 mg of beta-carotene once daily for 90 days, and the final results

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were compared to baseline. Those who received the 30-mg dose showed improvements in facial rhytides and elasticity, increased type I procollagen messenger RNA levels, decreased UV-induced thymine dimer staining, and decreased 8-hydroxy-2′-deoxyguanosine staining. The lower dose of beta-carotene was found to prevent photoaging and was superior to the higher dose, which actually significantly decreased the minimal erythema dose (indicating a deleterious effect)(P=.025).[8]

Another study compared the role of a 25-mg carotenoid supplement vs a combination of carotenoid and vitamin E (335 mg [500 IU] RRR-α-tocopherol) supplements in preventing erythema development on the back.[9] Using a blue light solar stimulator for illumination, erythema on the dorsal back skin was significantly reduced after week 8 (P<.01). The erythema was lower in the combination group than the carotenoid group alone, but the difference was not statistically significant. Furthermore, after 12 weeks, yellowing of the skin was observed in both groups, especially the skin of the palms and face.[9]

Collagen peptides also have been used in the prevention and repair of photoaging. Proksch et al[10] conducted a double-blind, placebo-controlled trial to investigate the role of collagen peptides on skin elasticity in 69 women aged 35 to 55 years. At 4 weeks, oral supplementation of collagen hydrolysate (2.5 g once daily or 5 g once daily for 8 weeks) showed significant (P<.05) improvement of skin elasticity in both the low-dose and high-dose groups in women older than 50 years; however, collagen peptides did not lead to statistically significant improvement in skin hydration or transepidermal water loss. No known side effects were reported; thus, collagen peptides may be both efficacious and safe in improving signs of photoaging in elderly patients.[10] Thus, these studies have shown potentially positive effects of beta-carotene, vitamin E, and collagen peptides in improving the signs of photoaging.

Acne Vulgaris

Acne vulgaris is a common dermatologic condition seen in the western hemisphere, with 40 to 50 million affected individuals in the United States annually.[11,12] A landmark study that examined 1200 Kitavans from Papua New Guinea and 115 Aché individuals from a hunter-gatherer community in Paraguay found no cases of AV in either group.[12] These findings have led to the speculation that AV may be associated with environmental factors, particularly the Western diet.

An investigator-blinded randomized clinical trial (RCT) explored the role of a low-glycemic diet compared to a carbohydrate-dense diet on improvement of AV lesions after 12 weeks.[13] The results yielded a significant decrease in lesions in the low-glycemic group (mean [SEM], −23.5 [−3.9]) vs the control group (−12.0 [−3.0])(P=.03). Furthermore, the results indicated a significant decrease in weight (P<.001) and body mass index (P=.001) with an improvement in insulin sensitivity in the low-glycemic group vs the control group.[13] Kwon et al[14] conducted a similar investigator-blinded parallel study with 32 participants receiving either a low-glycemic diet or continuing their normal diet for 10 weeks. Participants in the low-glycemic group demonstrated a significant reduction in mean noninflammatory lesions (−27.6% [P=.04]) and mean inflammatory lesions (−70.9% [P<.05]). Histologic image analysis showed a significant decrease in the mean (SEM) area of sebaceous glands in the low-glycemic group (0.32 [0.03] mm^2) compared to baseline (0.24 [0.03] mm^2) (P=.03). At 10 weeks, immunohistochemical specimens showed reduction in IL-8 (P=.03) and sterol regulatory element-binding protein 1 (P=.03), which regulates the synthesis of lipids.[14] Thus, both studies concluded that a reduction in glycemic load may improve acne overall.[13,14]

Another study attempted to investigate the role of additional dietary supplements in improving acne. A double-blinded RCT explored the efficacy of omega-3 fatty acids or γ-linoleic acid compared to a control group in improving mild to moderate AV lesions through clinical and histological evaluations.[15] The 10-week prospective study included 45 patients who were allocated to 3 matched groups and randomized to 3 treatment arms. They were given omega-3 fatty acids (1000 mg each of eicosapentaenoic acid and docosahexaenoic acid) or γ-linoleic acid (borage oil with 400 mg of γ-linoleic acid) or no intervention. After treatment completion, patients in both treatment groups showed significant reduction in mean inflammatory acne lesions, mean noninflammatory acne lesions, and mean acne severity (all P<.05), while the control group showed no significant reduction in acne lesions or acne severity. Furthermore, hematoxylin and eosin and IL-8 immunohistochemical staining of biopsies from the affected areas showed significant reduction of inflammation in both treatment groups (P<.05) but not in the control group. Therefore, the authors concluded that both omega-3 fatty acids and γ-linoleic acid could be used as adjuvant therapies in AV treatment.[15]

Atopic Dermatitis

The prevalence of atopic dermatitis (AD) in children ranges from approximately 9% to 18% across the United States.[16] Pyridoxine, or vitamin B_6, is an important water-soluble vitamin and a cofactor for numerous biochemical processes including carbohydrate and amino acid metabolism pathways and glucocorticoid receptor regulation.[17,18] However, a double-blinded, placebo-controlled RCT failed to show efficacy of once-daily pyridoxine hydrochloride 50 mg in improving erythema, itching, or nocturnal sleep disturbance associated with AD in a cohort of 48 children. The investigators concluded that pyridoxine supplementation cannot be recommended to improve the symptoms of AD in children.[19]

Zinc is an essential nutrient that functions as an important cofactor in cell metabolism and growth pathways.[20] One study showed that intracellular erythrocyte zinc levels were significantly lower in AD patients compared to healthy controls (P<.001); however, there was no observed difference in serum zinc levels (P=.148).

Furthermore, greater disease severity as determined by the SCORing Atopic Dermatitis (SCORAD) index was negatively correlated with erythrocyte zinc levels ($r=-0.791$; $P<.001$).[21] Kim et al[22] investigated hair zinc levels and the efficacy of oral zinc supplementation in children with mild to moderate AD. Mean (SD) hair zinc levels were lower in the AD group compared to the control group (113.10 [33.6] μg vs 130.90 [36.63] μg [$P=.012$]). Of 41 AD patients with low zinc levels, 22 were allocated to group A, which received oral zinc oxide 12 mg for 8 weeks, and 19 were allocated to group B, which did not receive any supplementation over the same period. Groups A and B also received oral antihistamines and topical moisturizers. Mean (SD) zinc levels increased significantly in group A from 96.36 (21.05) μg to 131.81 (27.45) μg ($P<.001$). Furthermore, relative to group B, group A showed significantly greater improvements in eczema area and severity index ($P=.044$), transepidermal water loss ($P=.015$), and visual analog scale for pruritus ($P<.001$) at the end of 8 weeks. The authors concluded that oral zinc supplementation might be an effective adjunctive therapy for AD patients with low hair zinc levels.[22]

Researchers also have explored the efficacy of fat-soluble vitamins D and E in treating AD. Vitamin D is thought to downregulate IgE-mediated skin reactions and decrease adverse effects of UV light on the skin.[23,24] A double-blind, placebo-controlled trial randomized 45 patients with AD to 4 groups: vitamins D and E placebos (n=11), 1600 IU vitamin D_3 plus vitamin E placebo (n=12), 600 IU vitamin E (synthetic all-*rac*-α-tocopherol) plus vitamin D placebo (n=11), and 1600 IU vitamin D_3 plus 600 IU vitamin E (synthetic all-*rac*-α-tocopherol)(n=11).[25] After 60 days, the SCORAD index was reduced by 28.9% in the placebo group, 34.8% in the vitamin D_3 group, 35.7% in the vitamin E group, and 64.3% in the combined vitamins D and E group ($P=.004$). Furthermore, prior to intervention, a negative correlation was demonstrated between plasma α-tocopherol concentration and the SCORAD index ($r=-.33$; $P=.025$).[25] Thus, supplementing vitamins D and E may play a beneficial role in the treatment of AD.

Other emerging studies are investigating the role of the gut microbiome in various pathologies. Prebiotics may alter the gut microbiome and are thought to play a role in reducing intestinal inflammation.[26] One randomized, placebo-controlled, parallel study examined the effect of prebiotic oligosaccharide supplementation on the development of AD in at-risk children, defined as having a biological parent with a history of asthma, allergic rhinitis, or AD.[27] At 6-month follow-up, 10 infants (9.8%) (95% CI, 5.4%-17.1%) in the intervention group (n=102) and 24 infants (23.1%)(95% CI, 16.0%-32.1%) in the placebo group (n=104) had developed AD. The authors postulated that the prebiotic oligosaccharides might play a role in immune modulation by altering bowel flora and preventing the development of AD in infancy.[27]

Notably, a 2012 Cochrane review evaluated 11 studies of dietary supplements as possible treatment options for AD. The authors concluded that the evidence was minimal to support the regular use of dietary supplements, especially due to their high cost as well as the possibility that high levels of certain vitamins (eg, vitamin D) may cause long-term complications.[26]

Psoriasis

Psoriasis is an autoimmune skin condition that has an annual prevalence ranging from approximately 1% to 9% in adults residing in Western countries.[28,29] Some have argued that due to decreased bacterial diversity and increased bacterial growth in the small bowel, psoriatic patients are exposed to higher levels of bacterial peptidoglycans and endotoxins.[30] To combat the absorption of these substances in psoriasis patients, we advocate for a vegetarian diet with low fats, limited alcohol consumption, and supplements of bile acids and bioflavonoid.

The effects of very long chain fatty acids also have been examined. A 4-month, double-blind, multicenter RCT compared the effects of daily supplementation with 6 g of either omega-3 fatty acids or omega-6 fatty acids in patients with mild to moderate plaque psoriasis.[31] Psoriasis area and severity index scores and patient subjective scores did not change significantly in either group; however, scaling was reduced in both groups ($P<.01$). The group receiving omega-3 fatty acids had decreased cellular infiltration ($P<.01$), and the group receiving omega-6 fatty acids had decreased desquamation and redness ($P<.05$). In the omega-6 group, there was a significant correlation between clinical improvement (decrease in clinical score) and increase in serum eicosapentaenoic acid ($r=-0.34$; $P<.05$) and total omega-3 fatty acids ($r=-0.36$; $P<.05$). Overall, the authors concluded that supplementation with omega-3 fatty acids (fish oil) was no better than omega-6 fatty acids (corn oil) for treatment of psoriasis.[31]

Some dermatologists have advocated for the use of oral vitamin D supplementation as an adjunctive treatment of psoriasis, given that it is inexpensive and also may play a role in reducing the risk for cancer and cardiovascular events.[32] One study evaluated the level of 25-hydroxy vitamin D in 43 psoriasis patients compared to 43 healthy controls. Mean (SD) vitamin D levels were significantly lower in psoriasis patients (13.3 [6.9]) compared to controls (22.4 [18.4])($P=.004$).[33] A cross-sectional study similarly found significantly higher rates of vitamin D deficiency (25-hydroxy vitamin D <20 ng/mL) in psoriatic patients (57.8%) compared to patients with rheumatoid arthritis (37.5%) and healthy controls (29.7%)($P<.001$). Interestingly, during winter the prevalence of vitamin D deficiency increased to 80.9%, 41.3%, and 30.3% in the 3 groups, respectively; however, no significant correlation was seen between psoriasis severity, as measured by psoriasis area and severity index, and serum vitamin D levels.[34] Although vitamin D deficiency may be more prevalent among patients with psoriasis, data regarding the efficacy of treating psoriasis with oral vitamin D supplementation is still lacking.

Conclusion

Our understanding of the link between diet and dermatologic conditions continues to evolve. Recent data for several dietary supplements and therapies showed promising results in repairing signs of photoaging, as well as treating AV, AD, and psoriasis. As patients seek these adjunctive therapies, it is important for physicians to be well informed on the benefits and risks to appropriately counsel patients.

Globally, physicians advocate for a low-glycemic diet rich in fruits and vegetables. Furthermore, the cosmetic diet can be enhanced by the consumption of dietary supplements such as beta-carotene, collagen peptides, zinc, and fat-soluble vitamins such as vitamins D and E. However, prospective RCTs are needed to further investigate the role of these dietary elements in treating and improving dermatologic conditions.

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