

## **Beauty and Nutrition — Evidence-Based Dietary Practices Can Help Patients Look and Feel Their Best**

**By Ana Gabriela Reisdorf, MS, RD, CDE**

*Suggested CDR Learning Codes: 3100, 4000, 5090, 5420; Level 2*

*Suggested CDR Performance Indicators: 8.1.4, 8.3.6, 10.4.4, 12.2.1*

Beauty is big business. According to a special report published in *The Economist*, approximately \$160 billion is spent annually on beauty products worldwide.<sup>1</sup> It's clear that consumers are willing to spend a great deal of money to look great and stay youthful. But creams, potions, and lotions can only do so much. There are no products that can reverse the long-term consequences that poor lifestyle choices can have on appearance. Many consumers realize that beauty and youthfulness come from inner health and are curious about how they can enhance their appearance through proper diet, physical activity, and other healthful habits. RDs are in a unique position to help consumers not just stay healthy as a result of their dietary choices, but also look their best as well.

Nutrients, vitamins, and minerals have long been understood to have an influence on appearance. For example, kwashiorkor, a severe protein and calorie deficiency, is associated with skin lesions and light hair color, especially in children.<sup>2</sup> Pellagra, caused by niacin deficiency, leads to flaky skin and dermatitis. Other B vitamin deficiencies can cause skin rashes or cracks in the corners of the mouth.<sup>3</sup> Although it's uncommon to see these types of overt deficiencies today in the United States, diet and nutrition continue to have a significant impact on overall appearance.

This continuing education course identifies and examines current evidence about the role of nutrition in beauty. It explores the effect of dietary interventions and appropriate supplementation on reducing acne and wrinkles, managing skin dryness, and strengthening hair and nails.

### **Skin**

The skin is the largest organ in the human body. Its main function is to act as a barrier to protect the internal organs against pollution, toxins, dangerous microbes, and the environment. Underneath the top layer, the epidermis, the other layers of skin are connected to a vast vascular network that helps maintain healthy tissues, aids in wound healing, controls blood pressure, and mediates immune reactions. Due to this direct connection with the bloodstream, the skin usually is the first place nutrient deficiencies can be visibly identified, such as the common skin ailments seen with certain B vitamin deficiencies and protein malnutrition.<sup>4</sup> The addition or avoidance of certain foods, nutrients, and dietary supplements can affect other skin-related complaints such as acne, skin dryness, and wrinkles.

## Acne and Diet

Acne is a common skin condition that leads to pustule formation on the face, back, or chest. It's believed to affect 40 to 50 million people in the United States, making it the most common dermatologic condition.<sup>5</sup> Acne is a complex condition and the exact pathology isn't clearly understood. The inflamed pustules commonly seen in acne are related to the colonization of the skin's sebaceous cells by a type of bacteria called *Propionibacterium acnes*. This colonization increases inflammation of the skin, leading to increased sebum production, which causes a blockage of the follicular opening. The blockage can trigger an immune response that results in an inflamed pustule.<sup>5</sup>

Insulin and insulinlike growth factor (IGF-1) also may be culprits in the formation of acne pustules. Insulin specifically has been shown to elicit a hormonal response that increases sebum production, making acne worse. IGF-1 tends to peak during the teenage years and works hand in hand with other growth and sex hormones, such as testosterone, to increase sebum production.<sup>6</sup> Teenagers who have high levels of IGF-1 also tend to have more acne pustules.<sup>7</sup> Women with polycystic ovary syndrome, typically characterized by hyperinsulinemia and high IGF-1 levels, also often have acne.<sup>8</sup> The relationship between these hormones and acne isn't clearly understood, but it seems as though acne is a complex interaction between bacterial colonization, hormones, and inflammation.

Dietary interventions to help reduce acne have focused on decreasing insulin levels to help control sebum production. In 2007, Smith and colleagues assigned 43 male acne patients to a dietary intervention trial. Roughly one-half of the subjects were assigned a low-glycemic diet; the remaining participants weren't assigned any specific intervention. The subjects were asked to follow their assigned diet for 12 weeks. After 12 weeks, the total number of acne lesions had significantly decreased in the experimental group that had followed the low-glycemic diet. This group also lost weight and had improved insulin sensitivity when compared with the control group.<sup>9</sup> This study suggests that there may be a connection between dietary glycemic load, insulin sensitivity, and acne, although further research is needed to fully understand this connection.

It's commonly believed that eating chocolate causes acne. There have been only a few studies that have examined this belief, and better-designed studies are needed to determine if there is a true connection. The most thorough study on this topic to date, which was conducted by Fulton and colleagues, requested that study participants consume 1,200 kcal of chocolate daily. It was found that there was no significant increase in sebum production even after consuming such an enormous amount of chocolate.<sup>10</sup>

In a 2005 correlational study, Adebamowo and colleagues examined the connection between dairy intake and acne. Data from the Nurse's Health Study II were used to evaluate the possible link between drinking milk during adolescence and reports of physician-diagnosed severe acne. A positive association was found between total milk consumption and acne diagnosis. This connection also was seen with other dairy products such as cream cheese and sherbet. Researchers believe that dairy products may increase sex hormones, which increase sebum production, leading to an increase in acne.<sup>11</sup>

Based on current research, dietary recommendations for the management of acne should focus on decreasing the intake of high-glycemic foods, which are generally high in sugar or refined carbohydrates and low in nutrient content. Considerations also may be made to eliminate or reduce dairy intake, but adequate calcium intake may then become a concern. At this time, further research is needed to determine the exact protocol for reducing acne through dietary interventions.

### **Acne and Dietary Supplements**

Many dietary supplements and herbs also may be effective in treating acne. Traditionally, acne has been treated with antibiotics to help control the overgrowth of *P acnes*. The problem with this type of treatment is that antibiotics also can reduce levels of helpful bacteria, such as *Staphylococcus epidermidis*, found on the skin. Therefore, pre- and probiotics are being researched as a possible alternative to traditional antibiotic treatment to help maintain the skin's natural microbial balance. A 2013 study identified that the microorganism *S epidermidis* may have an inhibitory effect on the growth of *P acnes*.<sup>12</sup> However, further research is needed to determine whether probiotics should be applied to the skin directly or if they should be taken orally to have an effect on reducing acne. Also, ideal microbial strains and dosages need to be determined before a specific recommendation can be made.

Since acne is related to inflammation, anti-inflammatory and antimicrobial herbs and dietary supplements have been used to treat acne. Several herbs, such as Oregon grape root, goldenseal, and yellowroot, contain berberine, an active ingredient that helps inhibit the activity of *P acnes*, acting as an antimicrobial and anti-inflammatory agent. Ideal dosages of these herbs for acne haven't yet been determined.<sup>13</sup>

Turmeric, a popular Middle Eastern spice, has long been known to have antibacterial and anti-inflammatory properties. The active ingredient in turmeric is curcumin, which works to reduce inflammation by scavenging free radicals that can damage DNA and cell membranes.<sup>14</sup> The suggested dosage of curcumin is 400 to 600 mg three times daily because curcumin is poorly absorbed into the bloodstream. Fresh turmeric also can be added as a spice when cooking for a similar anti-inflammatory benefit.<sup>15</sup>

Omega-3 fatty acids, due to their anti-inflammatory properties, have been investigated due to the inflammatory response caused by bacterial overgrowth and linked to an increase in acne pustules. But, research studies evaluating omega-3s and acne have shown mixed results. Khayef and colleagues examined the effect of omega-3 supplements containing 930 mg of EPA on 13 individuals with inflammatory acne. Other dietary factors remained unchanged during the study. The researchers found that eight of the participants had an improvement in the number of acne pustules, whereas four individuals reported worsening of acne with the omega-3 supplementation.<sup>16</sup> Another small case study found that subjects saw a significant decrease in acne pustules after using a dietary supplement containing 1,000 mg of EPA after two months.<sup>17</sup> At this time, although omega-3 fats are known to be anti-inflammatory, it isn't clear if they're effective for the treatment of acne, and ideal dosages have yet to be determined.

Vitamin B<sub>12</sub> supplementation has been linked to an increase in acne pustules. A 2015 study by Kang and colleagues found that supplementation of B<sub>12</sub> led to the development of acne due to a change in the metabolism of *P. acnes*. Supplementation with vitamin B<sub>12</sub> led to the creation of compounds called porphyrins, which have been previously shown to increase inflammation, leading to increased acne lesions.<sup>18</sup>

Research into dietary supplements and acne has shown mixed results overall. There's some evidence that certain anti-inflammatory herbs and spices may be beneficial, but ideal dosages have yet to be determined. Probiotics have shown promise in acne treatment, but specific microbial strains and dosages haven't been identified.

### **Skin Dryness and Dullness**

Skin dryness is related to poor hydration in the cells, which causes cells to contract. True dehydration can lead to flaky, dry, dull-looking skin, but drinking more water doesn't always help improve dry skin. Other factors that may lead to dry skin include dry, winter weather; the use of certain soaps; and excessive sun exposure. However, sometimes skin remains dry even without these environmental factors at play due to eczema or other types of chronic dry skin conditions. Their underlying causes must first be treated, but diet can help improve them.

In order for skin cells to stay hydrated, the cells need to contain the proper types of fatty acids to help hold in water. The connection between skin moisture and dietary fats was first described in the 1930s, when unsaturated fats were excluded from the diets of rats. Researchers Burr and Burr found that rats developed a type of scaly dermatitis when the essential fatty acids, specifically linolenic and linoleic acid, were eliminated from their diet.<sup>19</sup> This research initiated an interest in how dietary fat can help skin retain moisture. To date, much of the research on skin dryness and diet has been conducted on subjects with atopic eczema, a skin condition that causes inflammation, flaky skin, and redness.

Certain polyunsaturated fats seem to play the biggest role helping skin retain moisture. The main roles of polyunsaturated fatty acids (PUFAs) in the skin are to maintain fluidity and flexibility in the cell walls as well as help with the synthesis of intercellular lipids that help with hydration. Most diets are adequate in PUFAs; therefore, it's believed that those with deficiencies in linoleic acid metabolism are most at risk of developing eczema.<sup>20</sup> PUFAs also are precursors to eicosanoids that help regulate inflammation levels, which can increase skin dryness.

Specifically, two types of PUFAs have been studied in regard to skin moisture: gamma-linolenic acid (GLA) and omega-3 fats. Both have had positive results in helping improve skin dryness. Omega-3 fatty acids, specifically EPA and DHA, have been shown to help reduce overall itching and scaling of the skin. In one study, subjects with dermatitis, or flaky skin, were given 1.8 g of EPA daily and were found to have a significant decrease in itchiness and improved moisture in the skin.<sup>21</sup> Dosages of up to 4 g of fish oil daily may be safe for those who don't have any diseases related to blood clotting.<sup>22</sup>

GLA, found in evening primrose oil, borage seed oil, and black currant seed oil, is also an anti-inflammatory omega-6 fatty acid. GLA is believed to modulate the inflammatory response by

working as a precursor to eicosanoids and prostaglandins.<sup>23</sup> However, research findings are still unclear about the dosage and efficacy of GLA in the improvement of dry skin. A 2008 study found that supplementation with 500 mg of evening primrose oil, high in GLA, showed a 96% reduction in symptoms in patients with eczema after five months.<sup>24</sup> Conversely, a 2013 review of 27 studies on evening primrose oil and borage seed oil found no significant effect on eczema symptoms across all studies.<sup>25</sup> Although there's some promise in the utilization of GLA to help improve skin dryness, further research is needed to determine its effectiveness and ideal dosages.

Other nutrients also have been identified in helping maintain skin hydration levels. A 2003 study by Boelsma and colleagues identified several dietary factors correlated with sebum production, low epidermal pH levels, and skin hydration. Researchers found an inverse association between serum vitamin A levels and sebum content, as vitamin A has been known to reduce the activity of the sebaceous cells. The same study found that high levels of serum B-cryptoxanthin, a carotenoid, were correlated with increased skin hydration, but only in men. The primary limitation of this study was that serum nutrient levels were measured, instead of directly measuring nutrient levels from the skin itself.<sup>26</sup> Further research is needed to determine exact nutrients that can help improve skin moisture.

## **Aging**

Biological attractiveness is based on youthful appearance of skin; therefore, those who have a desire to appear younger can do so by reducing the aged appearance of the skin. Aging of the skin can be exacerbated by a variety of factors including environmental pollutants, smoking, diet, and stress.<sup>27</sup> Two common qualities of an older appearance are wrinkled skin and loss of skin elasticity.

There are several foods that have been found to be possibly protective against skin damage that may lead to wrinkles. A 2001 study followed 450 subjects of various ethnicities living in different parts of the world to determine the connection between diet and sun damage. It was found that people with a diet high in vegetables, legumes, olive oil, and fish had a lower risk of sun damage. Foods that increased wrinkling from the sun's rays included butter, margarine, milk products, meat, carbohydrates, and sugar.<sup>28</sup>

A larger 2007 study analyzed data from the National Health and Nutrition Examination Survey to examine the connection between the appearance of the skin and diet. This study focused specifically on skin wrinkling, senile dryness, and skin thinning. The data revealed that women older than 40 with lower intakes of protein, dietary cholesterol, phosphorus, potassium, vitamin A, and vitamin C had a more wrinkled appearance. Women with drier skin, which can lead to increased wrinkling, also had lower intakes of vitamin C and linoleic acid.

The strongest correlation was found between vitamin C intake and wrinkled skin, even when confounding variables were controlled for. This may be due to the antioxidant effects of vitamin C. Vitamin C plays a role in collagen formation and skin regeneration, and has been found to be photoprotective. However, at this time, it's unclear whether it's the vitamin C itself that's protective or if it's a diet high in foods that contain vitamin C, as well as other antioxidants and nutrients, such as fruits and vegetables.<sup>29</sup>

## Topical Antioxidants

Foods and nutrients with antioxidant properties may play an important role in the prevention of aging due to their ability to reverse damage caused by free radicals. Free radicals are formed via normal human metabolism, ultraviolet exposure, and certain lifestyle factors such as alcohol consumption and smoking. These molecules cause damage to DNA and cell membranes.<sup>30</sup> Over time, the body's natural antioxidant levels decrease and free radical levels increase, leading to an aged appearance. Due to their importance in aging, foods and nutrients with antioxidant properties have been used both topically and orally to help prevent wrinkling and the appearance of aging.

Vitamin E, a fat-soluble antioxidant, is found in foods such as vegetable oils, seeds, and meat. The most active form of vitamin E in terms of aging and wrinkle prevention is A-tocopherol, which also has been shown to have the highest antioxidant activity of all the tocopherols. In animal studies, the application of A-tocopherol has been shown to have a photoprotective effect against sunburn when applied directly to the skin.<sup>31</sup> Similar results also have been found in humans; when tocopherol creams are applied directly to the skin, an improvement in sun-related aging has occurred.<sup>32</sup>

Vitamin C, a potent antioxidant found in various fruits and vegetables, may help fight wrinkles due to its role in collagen formation.<sup>29</sup> When applied topically, it has been shown to boost collagen production. Vitamin C has been studied extensively and found to protect against sun damage by helping reduce sunburn after exposure to both UVA and UVB radiation when applied topically. As a result, it has been added to multiple sunscreen and after-sun products to help scavenge free radicals and heal skin that has been damaged from sun exposure.<sup>33</sup> Few human studies have shown the improvement of wrinkles via topical application of vitamin C; however, more research is needed to determine the exact dosage and the best way to maintain the antioxidant activity of the vitamin in a packaged product.<sup>34</sup>

When applied topically in combination, vitamins E and C may create a synergistic effect in helping protect the skin from sun damage.<sup>35</sup> In a 2003 study published in the *Journal of the American Academy of Dermatology*, researchers applied a 15% vitamin C and 1% vitamin E solution to pig skin for four days and compared the skin with a control group that didn't receive the solution and two groups that received only a vitamin E or a vitamin C solution. During those four days, the pig skin received various levels of radiation and researchers measured the antioxidant protection factor, number of sunburn cells, and degree of redness. Those in the group that received the combination of vitamin E and vitamin C were four times more protected against sun damage than were those in the other groups.<sup>36</sup>

## Dietary Supplements

Dietary supplements also may help with preventing or reducing the appearance of wrinkles. Vitamins E and C can be used orally in addition to topically to help prevent wrinkles and sun damage. In a 1998 study, 40 subjects were given 2 g of A-tocopherol and 3 g of vitamin C per day. Subjects found that the combination of these two vitamins had a pronounced synergistic and photoprotective effect. Researchers believe these effects are related to the antioxidant activity of vitamins C and E.<sup>36</sup> Unfortunately, the dosages in this study were much higher than

that which most people can consume in a normal diet and than the Recommended Dietary Allowance.

Loss of skin elasticity is caused by a general decrease of collagen in the skin and can be a natural part of the aging process. Collagen's main role is to maintain skin integrity and firmness and promote wound healing. One study found that taking oral collagen supplements may help maintain skin elasticity. Women between the ages of 35 and 55 were given 2.5 g to 5 g of oral collagen for eight weeks and were found to have a significant increase in skin elasticity when compared with those who didn't take any supplements.<sup>37</sup> Collagen also has been injected directly into the skin to help improve the appearance of wrinkles and scars.<sup>38</sup>

Turmeric also may help improve collagen deposition. A 2006 study used curcumin to help with cutaneous wound healing in rats. The curcumin was found to increase collagen synthesis and cell growth in the wounded areas. The rats were able to heal much faster than those who didn't receive the curcumin treatment.<sup>39</sup> Further clinical trials are needed to determine the dose of curcumin necessary to help prevent wrinkles; at this time, adding turmeric as a spice to food may be a safe way to achieve some of the benefits.

There isn't sufficient evidence to recommend a specific protocol of dietary supplements for antiaging or wrinkle prevention. Adding certain foods with active ingredients to the diet may be a safe and healthful way to help prevent photoaging and wrinkles. For example, foods high in vitamin C do seem to be protective against sun damage and wrinkling, but it's unclear whether it's the vitamin C itself found in the food or another factor in vitamin C-rich foods that's protective. Foods high in vitamin C, such as some fruits and vegetables, have many other health benefits in addition to their potential to reduce wrinkles. Based on the review of the research, foods high in antioxidants, whether vitamin C or E or curcumin seem to have a positive effect on protecting the skin from sun damage and wrinkles. As more is discovered about these nutrients and their therapeutic properties, researchers will be able to determine more precisely how consumers can use them to remain looking youthful and vibrant.

### **Hair and Nails**

Hair loss affects approximately 80% of men and 50% of women. Both hair and nails are made from a protein called keratin. Therefore, any factor that affects hair usually will also affect nails. The cause of hair loss or brittle nails isn't always clear, but it may be related to anemia, fungal infections, and possibly a deficiency in L-lysine or other amino acids.<sup>40</sup> It's also common to see hair loss after significant weight loss or bariatric surgery.<sup>41</sup> However, sometimes the exact cause of hair loss is unclear, especially when nutritional deficiencies may not be present.

For premenopausal women, iron deficiency is common because of monthly menstrual blood loss and in pregnancy. It's less common for males and postmenopausal females to have iron deficiency. Some studies have indicated that women with low ferritin levels tend to have hair loss. However, the evidence is insufficient to recommend supplementation across the board.<sup>42</sup>

Vitamin D deficiency also may be linked to hair loss. Several tissues in the body, including the skin and hair, use vitamin D for optimal functioning. A 2002 animal study used genetically modified mice that lacked a specific receptor site for vitamin D. This inability to absorb vitamin

D led to complete hair loss and a condition similar to alopecia in humans by 8 months of age.<sup>43</sup> A 2013 study observed that women with hair loss had significantly lower levels of serum vitamin D compared with women not experiencing hair loss. This study was only observational; therefore, further research is needed to determine the exact connection between vitamin D status and hair loss.<sup>44</sup>

Hair regrowth after loss has been shown to be successful via supplementation with omega-3 and -6 fats and certain antioxidants. A 2015 study evaluated the effect of a dietary supplement of omega-3 and -6 fats, from black currant seed oil and fish, in combination with certain antioxidants on hair loss and regrowth in 120 female subjects. After six months, subjects reported a significant increase in hair regrowth and hair diameter.<sup>45</sup>

Brittle, easily cracked nails may have many causes. Excessive contact with chemicals, aging, and certain medical conditions, such as hypothyroidism, all may influence the appearance of nails. There are a few nutritional factors that may have an influence on the strength of nails. Biotin, a B vitamin, commonly has been used to help strengthen hair and nails. A Swiss study published in 1993 found that biotin supplementation of 1 to 2 mg per day for two months increased nail strength by 25% in approximately 63% of subjects.<sup>46</sup>

Overall, strong hair and nails may be attributed to multiple factors. First, it's critical to look for any underlying medical conditions or nutrient deficiencies that may be causing hair loss or brittle nails. Once those are corrected, biotin supplementation can be considered and may be effective for some people. There's no established Recommend Dietary Allowance for biotin—only an Adequate Intake level, which is currently set at 30 mcg per day for adults.

### **Conclusion**

Overall, nutrition can have a significant impact on overall appearance, affecting skin, hair, and nails from the inside out. Diet and certain dietary supplements have the potential to help reduce acne, decrease wrinkles, and strengthen hair and nails. The study of beauty and nutrition continues to evolve as more research is conducted. There's significant interest in this subject, especially with the aging population. RDs can be at the forefront of this area of study, implementing evidence-based practices to help people look and feel their best.

—Ana Gabriela Reisdorf, MS, RD, CDE, is a Lake Forest, California nutrition consultant, writer, and editor of the diet review website [RateMyDiets.com](http://RateMyDiets.com).

[Click Here for Patient Handout](#)

## References

1. Special report: the beauty business: pots of promise. *The Economist* website. <http://www.economist.com/node/1795852>. Updated May 22, 2003.
2. McKenzie CA, Wakamatsu K, Hanchard NA, Forrester T, Ito S. Childhood malnutrition is associated with a reduction in the total melanin content of scalp hair. *Br J Nutr*. 2007;98(1):159-164.
3. Barthelemy H, Chouvet B, Cambazard F. Skin and mucosal manifestations in vitamin deficiency. *J Am Acad Dermatol*. 1986;15(6):1263-1274.
4. Piccardi N, Manissier P. Nutrition and nutritional supplementation: impact on skin health and beauty. *Dermatoendocrinol*. 2009;1(5):271-274.
5. White GM. Recent findings in the epidemiologic evidence, classification, and subtypes of acne vulgaris. *J Am Acad Dermatol*. 1998;39(2 Pt 3):S34-S37.
6. Spencer EH, Ferdowsian HR, Bernard ND. Diet and acne: a review of the evidence. *Int J Dermatol*. 2009;48(4):339-347.
7. Aizawa H, Nakada Y, Nimura M. Androgen status in adolescent women with acne vulgaris. *J Dermatol*. 1995;22(7):530-532.
8. Cappel M, Mauger D, Thiboutot D. Correlation between serum levels of insulin-like growth factor 1, dehydroepiandrosterone sulfate, and dihydrotestosterone and acne lesion counts in adult women. *Arch Dermatol*. 2005;141(3):333-338.
9. Smith RN, Mann NJ, Braue A, Mäkeläinen H, Varigos GA. A low-glycemic-load diet improves symptoms in acne vulgaris patients: a randomized controlled trial. *Am J Clin Nutr*. 2007;86(1):107-115.
10. Fulton JE, Plewig G, Kligman AM. Effect of chocolate on acne vulgaris. *JAMA*. 1969;210(11):2071-2074.
11. Adebamowo CA, Spiegelman D, Danby FW, Frazier AL, Willett WC, Holmes MD. High school dietary dairy intake and teenage acne. *J Am Acad Dermatol*. 2005;52(2):207-214.
12. Wang Y, Kuo S, Shu M, et al. Staphylococcus epidermidis in the human skin microbiome mediates fermentation to inhibit the growth of Propionibacterium acnes: implications of probiotics in acne vulgaris. *Appl Microbiol Biotechnol*. 2014;98(1):411-424.
13. Dattner AM. From medical herbalism to phytotherapy in dermatology: back to the future. *Dermatol Ther*. 2003;16(2):106-113.

14. Sakarkar DM, Gonsalvis L, Fatima F, et al. Turmeric: an excellent traditional herb. *Plant Arch*. 2006;6(2):451-458.
15. Asher GN, Spelman K. Clinical utility of curcumin extract. *Altern Ther Health Med*. 2013;9(2):20-22.
16. Khayef G, Young J, Burns-Whitmore B, Spalding T. Effects of fish oil supplementation on inflammatory acne. *Lipids Health Dis*. 2012;11:165.
17. Rubin MG, Kim K, Logan AC. Acne vulgaris, mental health and omega-3 fatty acids: a report of cases. *Lipids Health Dis*. 2008;7:36.
18. Kang D, Shi B, Erfe MC, Craft N, Li H. Vitamin B12 modulates the transcriptome of the skin microbiota in acne pathogenesis. *Sci Transl Med*. 2015;7(293):293.
19. Burr GO, Burr MM. On the nature and role of the fatty acids essential in nutrition. *J Biol Chem*. 1930;86:587-621.
20. Horrobin, DF. Essential fatty acid metabolism and its modification in atopic eczema. *Am J Clin Nutr*. 2000;71(Suppl 1):367S-372S.
21. Bjørneboe A, Søyland E, Bjørneboe GE, Rajka G, Drevon CA. Effect of dietary supplementation with eicosapentaenoic acid in the treatment of atopic dermatitis. *Brit J Dermatol*. 1987;117(4):463-469.
22. Fish oil. WebMD website. <http://www.webmd.com/vitamins-supplements/ingredientmono-993-fish%20oil.aspx?activeingredientid=993&>. Updated June 9, 2015. Accessed June 12, 2015.
23. Kapoor R, Huang YS. Gamma linolenic acid: an anti-inflammatory omega-6 fatty acid. *Curr Pharm Biotechnol*. 2006;7(6):531-534.
24. Senapati S, Bangerjee S, Gangopadhyay DN. Evening primrose oil is effective in atopic dermatitis: a randomized placebo-controlled trial. *Indian J Dermatol Venereol Leprol*. 2008;74(5):447-452.
25. Bamford JT, Ray S, Musekiwa A, van Gool C, Humphreys R, Ernst E. Oral evening primrose oil and borage oil for eczema. *Cochrane Database Syst Rev*. 2013;4:CD004416.
26. Boelsma E, van de Vijver LP, Goldbohm RA, Klöpping-Ketelaars IA, Hendriks HF, Roza L. Human skin condition and its associations with nutrient concentrations in serum and diet. *Am J Clin Nutr*. 2003;77(2):348-355.
27. Guinot C, Malvy DJ, Ambroisine L, et al. Relative contribution of intrinsic vs extrinsic factors to skin aging as determined by a validated skin age score. *Arch Dermatol*. 2002;138(11):1454-1460.

28. Purba MB, Kouris-Blazos A, Wattanapenpaiboon N, et al. Skin wrinkling: can food make a difference? **J Am Coll Nutr.** 2001;20(1):71-80.
29. Cosgrove MC, Franco OH, Granger SP, Murray PG, Mayes AE. Dietary nutrient intakes and skin-aging appearance among middle-aged American women. **Am J Clin Nutr.** 2007;86(4):1225-1231.
30. Harman D. Aging: a theory based on free radical and radiation chemistry. **J Gerontol.** 1956;11(3):298-300.
31. Nachbar F, Korting HC. The role of vitamin E in normal and damaged skin. **J Mol Med (Berl).** 1995;73(1):7-17.
32. Mayer P, Pittermann W, Wallat S. The effects of vitamin E on the skin. **Cosmetics Toiletries.** 1993;108(2):99-109.
33. Humbert PG, Haftek M, Creidi P, et al. Topical ascorbic acid on photoaged skin. Clinical, topographical, and ultrastructural evaluation: double-blind study vs. placebo. **Exp Dermatol.** 2003;12(3):237-244.
34. Farris PK. Topical Vitamin C: a useful agent for treating photoaging and other dermatologic conditions. **Dermatol Surg.** 2005;31(7 Pt 2):814-817.
35. Lin JY, Selim MA, Shea CR, et al. UV photoprotection by combination topical antioxidants vitamin C and vitamin E. **J Am Acad Dermatol.** 2003;48(6):866-878.
36. Fuchs J, Kern H. Modulation of UV-light-induced skin inflammation by D-alpha tocopherol and L-ascorbic acid: a clinical study using solar simulated radiation. **Free Radic Biol Med.** 1998;25(9):1006-1012.
37. Porksich E, Segger D, Degwert J, Schunck M, Zague V, Oesser S. Oral supplementation of specific collagen peptides has beneficial effects on human skin physiology: a double-blind, placebo-controlled study. **Skin Pharmacol Physiol.** 2014;27(1):47-55.
38. Matthias CA, Fernandes D, Kolokythas P, Kaplan H, Vogt P. Percutaneous collagen induction therapy: an alternative treatment for scars, wrinkles, and skin laxity. **Plastic Reconstruct Surg.** 2008;121(4):1421-1429.
39. Panchatcharam M, Miriyala S, Gayathri VS, Suguna L. Curcumin improves wound healing by modulating collagen and decreasing reactive oxygen species. **Mol Cell Biochem.** 2006;290(1-2):87-96.
40. Rushton, DH. Nutritional factors and hair loss. **Clin Exp Dermatol.** 2002;27(5):396-404.
41. Neve HJ, Bhatti WA, Soulsby C, Kincey J, Taylor TV. Reversal of hair loss following vertical gastropasty when treated with zinc sulphate. **Obes Surg.** 1996;6(1):63-65.

42. Trost LB, Bergfeld WF, Calogeras E. The diagnosis and treatment of iron deficiency and its potential relationship to hair loss. *J Am Acad Dermatol*. 2006;54(5):824-844.
43. Xie Z, Komuves L, Yu QC, et al. Lack of the vitamin D receptor is associated with reduced epidermal differentiation and hair follicle growth. *J Invest Dermatol*. 2002;118(1):11-16.
44. Rasheed H, Mahgoub D, Hegazy R, et al. Serum ferritin and vitamin D in female hair loss: do they play a role? *Skin Pharmacol Physiol*. 2013;26(2):101-107.
45. Le Floch C, Cheniti A, Connetable S, Piccardi N, Vincenzi C, Antonella T. Effect of a nutritional supplement on hair loss in women. *J Cosmet Dermatol*. 2015;14(1):76-78.
46. Hochman LG, Scher RK, Meyerson MS. Brittle nails: response to daily biotin supplementation. *Cutis*. 1993;51(4):303-305.

## Quiz

**1. What is the best way to improve overall appearance in the long term?**

- A. Expensive beauty products
- B. Lifestyle choices, including diet and not smoking
- C. Cosmetic surgery
- D. Always using sunscreen

**2. What causes acne?**

- A. Eating lots of desserts, such as chocolate and ice cream
- B. Improper skin hygiene, such as not washing your face daily
- C. A complex interaction between bacteria, hormones, and inflammation
- D. A diet high in fat, especially saturated fats

**3. What is one dietary recommendation that has shown some success with controlling acne pustules?**

- A. A low-glycemic diet to control insulin levels
- B. A low-fat diet to help people lose weight
- C. A low-protein diet
- D. A low-chocolate diet

**4. Traditionally, antibiotics have been used to treat acne, but now there's some interest in using probiotics instead. What is the reason?**

- A. Probiotics seem to work better to prevent acne.
- B. Probiotics are less expensive than antibiotics.
- C. Antibiotics kill even helpful bacteria, and probiotics promote healthful bacteria.
- D. Probiotics are easier to use than antibiotics.

**5. What is the primary dietary factor that influences skin dryness?**

- A. Carbohydrates
- B. Protein
- C. Dairy
- D. Essential fatty acids

**6. What are the two types of fats that seem to be most involved in maintaining skin moisture?**

- A. Gamma-linolenic acid (GLA) and omega-3s
- B. GLA and omega-6s
- C. Saturated fats and GLA
- D. Polyunsaturated and saturated fats

**7. Foods that were found to be protective against wrinkling, based on a 2011 study, included which of the following?**

- A. Butter
- B. Dairy products
- C. Red meat
- D. Vegetables

**8. Which vitamin was found to be most protective against wrinkling based on National Health and Nutrition Examination Survey data?**

- A. Vitamin A
- B. Vitamin E
- C. Vitamin C
- D. Thiamin

**9. Which of the following has been most closely associated with improved skin collagen deposition?**

- A. Vitamin C
- B. Turmeric
- C. Omega-3 fats
- D. Biotin

**10. Hair loss is commonly seen in which of the following?**

- A. In people who've had significant weight loss or bariatric surgery
- B. In vegetarians
- C. In men only
- D. In people who wash their hair too often