

Natural Hair Supplements: Biotin and Collagen

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The purpose of this Evidence Review column is to provide information about current literature of relevance to plastic and aesthetic nurses.

Farris et al. (2023) presented and reviewed the data behind two natural supplements commonly recommended to improve hair growth and appearance. The authors referenced a total of 44 scholarly sources to examine the current trends and myths related to biotin and collagen hair supplements. This Evidence Review column summarizes the findings of their review.

HAIR THINNING

The processes involved with thinning hair are complex and, in most individuals, the appearance of thinning hair creates significant concerns. Generally, the first line of treatment for thinning hair is topical minoxidil. Notably, this treatment has a low adherence rate because it may affect hair texture and styling and can also cause scalp irritation. Oral minoxidil must be administered with caution to patients who have a history of hypertension or who are at risk for cardiovascular disease. An off-label treatment of low-dose oral minoxidil has been found to be effective; however, the side effects associated with this treatment include *hypertrichosis* (i.e., excessive hair growth on other areas of the body) and *pedal edema* (i.e., excessive fluid in the foot and ankle) (Farris et al., 2023).

Alternatively, *5- α reductase inhibitors* (i.e., enzymes that convert testosterone into dihydrotestosterone, a hormone that promotes male pattern baldness), such as finasteride or dutasteride may be prescribed. Although these medications provide an effective treatment for thinning hair, patients may be reluctant to use them because of the associated side effects (e.g., decreased libido, sexual dysfunction) (Farris et al., 2023).

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Individuals with thinning hair are increasingly seeking natural, over-the-counter therapies. Google searches for minoxidil, biotin, and collagen have increased since 2005, with searches for collagen increasing dramatically since 2016. There is a wealth of misinformation being spread by social media and word-of-mouth. Likewise, there are multiple products available on the market with unsubstantiated claims for hair regrowth. For this reason, it is prudent for plastic and aesthetic nurses to be informed about the evidence supporting nutraceutical solutions for thinning hair (Farris et al., 2023).

BIOTIN

Twenty-nine percent of consumers take supplements containing biotin and 43.9% of physicians and dermatologists recommend taking biotin to address concerns related to hair (59%) and nail (86.9%) growth (Falotico & Lipner, 2022; Waqas et al., 2022).

Vitamin B₇, or *biotin*, is an essential body element for metabolizing fatty acids, carbohydrates, and amino acids. Biotin helps break down food into glucose, which is the primary energy source for the body and the brain, and also plays an important role in producing adenosine triphosphate, stabilizing *chromatins* (i.e., chromosomal protein, RNA, and DNA), expressing genes, and regulating oxidative stress (Bistas & Tadi, 2022; Saleem & Soos, 2023). Biotin is also a necessary element for the *mitochondrial carboxylases* (i.e., enzymes in the mitochondria that catalyze inorganic carbon) located in the hair roots (Farris et al., 2023). Biotin is a water-soluble molecule that is rapidly metabolized and excreted from the body (Grimsey et al., 2017).

Hair follicles replicate at an extremely fast rate and require high levels of energy. Biotin plays an essential role in producing energy at the hair root and is essential to keratin synthesis, which contributes to healthy hair, skin, and nails (Farris et al., 2023).

Daily Intake

According to the United States Food and Drug Administration (FDA), an adequate daily intake of biotin is 30 mcg, and most individuals consume approximately 35–70 mcg per day (Institute of Medicine Standing Committee on the Scientific Evaluation of Dietary Reference Intakes and Its Panel on Folate, Other B Vitamins, and Choline, 1998).

Biotin is contained in a variety of foods including chicken, eggs, nuts, and cheese. Additionally, bacteria in the large intestine can synthesize sufficient biotin for bodily function without obtaining it from food (Katta & Guo, 2017).

Biotin Deficiency

Biotin deficiency is extremely rare and is only found in individuals with chronic alcohol use, patients on long-term anticonvulsant therapy, and patients with genetic conditions that affect the absorption and metabolism of biotin (Institute of Medicine Standing Committee on the Scientific Evaluation of Dietary Reference Intakes and Its Panel on Folate, Other B Vitamins, and Choline, 1998; Said, 2011; Saleem & Soos, 2023). Biotin deficiency can lead to alopecia, *periorificial dermatitis* (i.e., a scaly, red rash around the eyes and the mouth), conjunctivitis, and skin infections (Katta & Guo, 2017). Insufficient levels of biotin have also been reported in patients using antibiotics for prolonged periods (e.g., to treat acne) and in patients taking isotretinoin for acne (Aksac et al., 2021; Saleem & Soos, 2023).

Supplementation

Biotin supplementation is essential for patients with biotin deficiency; however, evidence supporting the use of biotin in amounts above normal limits is meager (Almohanna et al., 2019; Katta & Guo, 2017; Thompson & Noori, 2021). To date, there are no clinical trials showing that administering biotin supplements in individuals with no underlying conditions and consuming a traditional diet improves hair growth (Soleymani et al., 2017). There is some evidence that using biotin supplements may improve nail strength and growth, although the mechanism and effective doses have yet to be determined (Colombo et al., 1990; Miot & Schmitt, 2021).

The recommended daily intake of biotin ranges between 30 and 70 mcg. Notably, there is no known toxicity level or upper limit of dosage, even when administering 10,000 times this amount. It is well known that at these extremely high doses, biotin improves the clinical outcomes and quality of life of patients with progressive multiple sclerosis (FDA, 2019).

False Laboratory Results

Although it is not toxic, consuming excessively high levels of biotin can cause false laboratory results (FDA, 2019). Taking exorbitantly high doses of biotin (e.g., 20,000–100,000 mcg daily) has been shown to interfere with biomarker detection during diagnostic testing, producing

false-positive or false-negative laboratory results. Specifically, the FDA reported that circulating biotin levels of 1,200 ng/mL can interfere with troponin assays and produce a false-negative result for heart attack. Other biomarkers that may be affected include 25-OH vitamin D, human chorionic gonadotropin, thyroid hormones, hepatitis, or HIV tests (FDA, 2022; Setty et al., 2020). Based on the type of assay, the effect can be an artificial increase or decrease (Li et al., 2020).

To prevent the effect that biotin may have on laboratory tests, patients who have taken 5,000–10,000 mcg of biotin should wait 8–12 hr before having their blood collected for laboratory tests (Grimsey et al., 2017). If the patient is taking less than 5,000 mcg per day, this is not as much of a concern (Grimsey et al., 2017; Setty et al., 2020). Surprisingly, despite announcements from the FDA, approximately 1 in 5 physicians (19.5%) are unaware of the potential interference of biotin with laboratory results (Falotico & Lipner, 2022).

Summary

Biotin is an essential component of skin, hair, and nails. When used in combination with other vitamins and nutraceuticals, biotin has shown efficacy in improving hair growth (Ablon & Kogan, 2018). Although a balanced nutritional diet provides sufficient biotin to support healthy and strong hair growth, the addition of biotin supplements is generally considered safe. Daily doses of more than 5,000 mcg do not provide additional benefits and can interfere with the results of diagnostic laboratory testing (Setty et al., 2020).

COLLAGEN

Collagen is the most abundant protein in the human body. It is a large, fibrous scaffold that forms the structural components of the hair, skin, bones, joints, and tendons. There are more than 27 different types of collagen, each distinguishable by its structure, function, and location in the body. The most abundant types of collagen are types I, II, and III, with type I and type III being the most prominent forms in the skin and hair (Campos et al., 2015; Deshmukh et al., 2016).

Collagen is produced in the *mesenchymal cells* (i.e., cells that form and maintain connective tissue throughout the body). These cells include dermal *fibroblasts* in the skin and hair, *chondrocytes* in the bone and cartilage, *osteoblasts* in the bone, and *cementoblasts* in the teeth (Deshmukh et al., 2016).

Collagen accounts for approximately 70% of the dry weight of the skin. When intact, the collagen network maintains elasticity and hydration to the skin, scalp, and hair follicle (Baumann, 2007).

Collagen Deficiency

Beginning at approximately age 30, the amount of collagen in the body decreases by approximately 1% per year (Shuster et al., 1975). As a result, the structural support for the skin shrinks, the skin looks dull, and fine lines and wrinkles develop. Microscopically, the dermal collagen network becomes disrupted and accumulates shortened and disorganized collagen fibers. The cells that synthesize new collagen (i.e., fibroblasts) slow down and are unable to maintain the demand for fresh collagen to maintain the dermal layer (Baumann, 2007).

Advanced Glycation Endproducts

Another mechanism of aging results from the build-up of *advanced glycation endproducts* (AGEs) (Gautieri et al., 2014). AGEs form when circulating sugars combine with proteins or nucleic acids and contribute to collagen breakdown by decreasing the mechanical strength of the collagen molecule and breaking down the collagen structure (Liu et al., 2014). Because these high levels of sugars readily bind to collagen molecules, people with type II diabetes are particularly affected by AGE damage (Gautieri et al., 2014). Collagen has a very slow turnover rate; therefore, these disruptions remain in place for long time, ultimately weakening the skin, hair, and nails (Deshmukh et al., 2016; Gautieri et al., 2014). AGEs also attach to the *dermal papilla* (i.e., cells located at the base of the hair follicle that are responsible for growth and recycling of the hair). This causes oxidative stress and an inflammatory response that accelerates the breakdown of collagen (Miyata et al., 2015). As the aging process depletes collagen stores, there is less intact, complete collagen to replace and repair the collagen damaged by AGEs.

Supplementation

Increasing collagen intake (either by consuming collagen-rich foods or collagen supplements) has been shown to be effective in improving hair, skin, and nail health (Oesser, 2020). Collagen-rich foods include bone broth, fish, chicken, egg whites, leafy greens, and algae spirulina.

There is evidence to show that supplementing a normal diet with oral collagen increases the supply of collagen peptides delivered through the bloodstream (Asserin et al., 2015). Collagen supplements generally come from three sources: *bovine* (i.e., beef), *porcine* (i.e., pig), or *marine* (i.e., fish) (León-López et al., 2019). Marine-sourced collagen may have improved absorption rates and also has low inflammatory profiles and fewer concerns related to biological contaminants that may be associated with traditional animal-derived sources (e.g., toxins, viruses, and bacteria). Likewise, there are fewer religious concerns about using collagen derived from fish rather than bovine or porcine sources.

Collagen supplements integrate into the skin and provide the amino acids used by the fibroblasts to form new collagen. This reduces fragmentation of the dermal layer and helps reduce signs of aging (Asserin et al., 2015). The collagen peptides bind to the fibroblast membrane receptors and trigger new collagen synthesis and protein translation (León-López et al., 2019). Collagen peptides also display antioxidant and antimicrobial activities (Choi et al., 2019; León-López et al., 2019).

Summary

The benefits of oral collagen supplements are still being investigated; however, there is evidence to show that using oral collagen supplements has positive effects on the skin (Choi et al., 2019; de Miranda et al., 2021), reduces skin aging (de Miranda et al., 2021), increases hair thickness while decreasing dryness and dullness (Oesser, 2020), and increases nail growth while improving nail strength and preventing breakage (Oesser, 2020). Notably, collagen supplements are *dose-dependent* (i.e., increasing intake within the therapeutic range will increase the amount of collagen integrated into the dermal layer) (Asserin et al., 2015).

In a comprehensive review of clinical studies, Paul et al. (2019) found that taking 2.5–15 g of collagen peptides daily was below the maximum level of collagen that may be safely incorporated in the standard American diet. Although there is sufficient data to establish the use of oral collagen supplements as an important tool in promoting skin, hair, and nail health, additional controlled trials are needed to better understand the full benefits and determine best practices for the source, form, dose, and quality of oral collagen supplements (Farris et al., 2023).

CONCLUSION

There is no clinical evidence that biotin supplementation in a healthy population improves hair growth and quality. Moreover, large doses of biotin can affect laboratory results. On the other hand, there is emerging clinical evidence that supplemental collagen improves skin and hair health, but the form, source, dose, and quality of the supplement make determining the benefits difficult to extrapolate.

Hair loss and thinning are likely the result of multiple causative factors that include inflammation, oxidative damage, environmental assaults, aging, emotional stress, and hormonal imbalances. Based on this current understanding, a multimodal approach seems warranted.

If you have read or know about an important study relevant to plastic and aesthetic nurses and would like to write about it or see it presented in the Evidence Review column of Plastic and Aesthetic Nursing, please contact Sharon Ann Van Wicklin, Editor-in-Chief at sharonvurn@ispan.org.

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