

Vitamins and Minerals: For Healthy Skin, Hair, Nails

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Introduction

Vitamins and minerals are fundamentally important for maintaining the structural integrity and aesthetic appearance of skin, hair, and nails. Specific micronutrients, including Vitamin A, C, D, E, biotin, zinc, iron, and selenium, perform multifaceted roles. These roles encompass antioxidant defense, collagen synthesis, cell proliferation, and the promotion of healthy hair follicles. Deficiencies or imbalances in these micronutrients can manifest visibly, leading to conditions such as brittle nails, hair thinning or loss, and various dermatological issues. This article aims to elucidate the scientific basis underpinning these relationships and examine the direct impact of dietary intake on observable health and appearance. [1]

Vitamin A and its derivatives are known to significantly influence sebum production and the functionality of the skin barrier. Retinoids, which are the biologically active forms of vitamin A, play a critical role in regulating keratinocyte differentiation and are indispensable for efficient epidermal renewal. A thorough understanding of the underlying mechanisms through which vitamin A affects skin health is crucial for developing effective therapeutic strategies for a range of dermatological conditions. [2]

Vitamin C, also known as ascorbic acid, is a potent antioxidant with a vital role in collagen synthesis, the primary structural protein responsible for skin's firmness and elasticity. Its involvement in wound healing processes and its protective capabilities against damage induced by ultraviolet (UV) radiation make it an indispensable nutrient for preserving skin youthfulness and overall integrity. Furthermore, the reduction of oxidative stress facilitated by vitamin C contributes positively to the health of both hair and nails. [3]

The influence of Vitamin D extends significantly to skin cell proliferation and differentiation processes. It also plays an important role in mediating immune responses within the skin. A documented link exists between Vitamin D deficiency and the exacerbation or development of conditions such as psoriasis and eczema, underscoring its critical importance for maintaining epidermal health. Additionally, its systemic effects indirectly support the cyclical nature of hair follicle activity. [4]

Vitamin E, a fat-soluble antioxidant, is vital for protecting cellular membranes from oxidative damage. This protective action directly contributes to maintaining the skin's barrier function and reducing inflammatory processes. Its photoprotective properties are widely recognized and aid in preventing premature aging and damage to the skin caused by UV exposure. This protective effect also extends to the scalp and the crucial hair follicles. [5]

Biotin, a member of the B-complex vitamin group, is widely acknowledged for its crucial role in the production of keratin, the primary structural protein that constitutes hair and nails. While instances of severe biotin deficiency are relatively rare, even suboptimal dietary intake can lead to noticeable hair thinning and the development of brittle nails. Consequently, biotin supplementation is frequently

explored as a strategy for enhancing nail strength and promoting hair growth. [6]

Zinc is an essential mineral that plays a critical role in fundamental cellular processes including cell division, DNA synthesis, and protein formation. These processes are vital for effective skin regeneration, efficient wound healing, and the maintenance of robust immune function. Zinc deficiency can manifest in various dermatological issues such as acne, hair loss, and impaired nail growth. Furthermore, zinc plays a regulatory role in sebum production. [7]

Iron deficiency anemia stands out as a prevalent cause of hair loss, particularly among women. Iron is indispensable for the effective transport of oxygen to the hair follicles, and insufficient iron levels can disrupt the normal hair growth cycle. The mineral's involvement in keratinocyte proliferation also directly impacts the health and development of nails. [8]

Selenium is a key constituent of selenoproteins, which are crucial antioxidants and also participate in thyroid hormone metabolism, thereby indirectly influencing hair growth. A deficiency in selenium has been associated with both hair loss and nail abnormalities. Its potent antioxidant properties also serve to protect the skin from oxidative stress, contributing to overall skin health. [9]

This comprehensive review serves to consolidate the current scientific understanding of how a diverse array of vitamins and minerals contribute synergistically to the overall health and aesthetic appearance of the skin, hair, and nails. The review places significant emphasis on the paramount importance of a well-balanced diet that is rich in essential micronutrients. It also explores potential correlations between specific micronutrient deficiencies and common dermatological issues, thereby highlighting promising avenues for future research and practical clinical applications. [10]

Description

Micronutrients, encompassing both vitamins and minerals, are indispensable for sustaining the structural integrity and enhancing the aesthetic quality of the skin, hair, and nails. A spectrum of specific nutrients, including Vitamin A, C, D, E, biotin, zinc, iron, and selenium, contribute through their diverse functionalities, ranging from providing antioxidant defense and supporting collagen synthesis to facilitating cell proliferation and maintaining the health of hair follicles. Identified deficiencies or imbalances within these micronutrient categories can readily manifest as observable issues like brittle nails, thinning or loss of hair, and a variety of skin conditions. This article delves into the scientific underpinnings of these interrelationships and analyzes the profound impact that dietary intake has on visible indicators of health. [1]

The physiological processes governing sebum production and the maintenance of a healthy skin barrier are significantly modulated by Vitamin A and its various ac-

tive derivatives. Retinoids, which are the metabolically active forms of Vitamin A, are critical regulators of keratinocyte differentiation and are absolutely essential for the continuous renewal of the epidermis. A deeper comprehension of the precise molecular mechanisms by which Vitamin A influences skin physiology holds substantial promise for the informed development of targeted therapeutic interventions for numerous dermatological ailments. [2]

Vitamin C, or ascorbic acid, functions as a powerful antioxidant agent and plays an indispensable role in the synthesis of collagen, the primary structural protein that provides skin with its foundational support and elasticity. Its crucial involvement in the complex process of wound healing, coupled with its capacity to shield the skin from damage induced by ultraviolet radiation, makes it a vital nutrient for maintaining youthful skin and preserving its structural integrity. The antioxidant capacity of Vitamin C also significantly contributes to promoting healthier hair and stronger nails. [3]

Vitamin D's influence on dermal health extends beyond its well-known roles in calcium metabolism. It actively participates in the proliferation and differentiation of skin cells and plays a role in modulating the skin's immune responses. Documented associations between Vitamin D deficiency and the exacerbation of chronic skin conditions like psoriasis and eczema highlight its importance for maintaining epidermal homeostasis. Furthermore, its systemic effects indirectly contribute to the regulation of the hair follicle cycling process. [4]

As a lipid-soluble antioxidant, Vitamin E is critical for protecting cell membranes from the damaging effects of oxidative stress. This protective function directly enhances the skin's barrier properties and helps to mitigate inflammatory responses. The photoprotective capabilities of Vitamin E are well-established, offering significant protection against photoaging and UV-induced skin damage. This protective effect extends importantly to the scalp and the vital hair follicles, supporting their health. [5]

Biotin, a vital member of the B-complex vitamin family, is widely recognized for its fundamental role in the synthesis of keratin, the principal protein component of hair and nails. Although severe deficiencies are uncommon, even marginally suboptimal dietary levels of biotin can lead to a noticeable thinning of hair and the development of fragile, brittle nails. Consequently, biotin supplementation is a commonly explored therapeutic avenue for improving nail strength and encouraging hair growth. [6]

Zinc is an essential mineral that is indispensable for numerous cellular functions critical to skin health, including cell division, DNA synthesis, and protein formation. These processes are fundamental for effective skin regeneration, efficient wound healing, and the robust functioning of the immune system. Zinc deficiency can precipitate various dermatological issues such as acne vulgaris, alopecia (hair loss), and impaired nail growth. Moreover, zinc plays a regulatory role in controlling sebum production by the sebaceous glands. [7]

Iron deficiency anemia is a widely recognized and significant contributor to hair loss, particularly in the female population. Iron's role in facilitating oxygen transport to the hair follicles is paramount, and inadequate iron levels can disrupt the delicate hair growth cycle, leading to premature shedding. The mineral's involvement in the proliferation of keratinocytes also directly influences the health and structural integrity of the nails. [8]

Selenium functions as a critical component of selenoproteins, a group of enzymes that possess potent antioxidant activities. Selenium also participates in the metabolism of thyroid hormones, which indirectly influences the hair growth cycle. A deficiency in selenium can be associated with an increased incidence of hair loss and the development of nail abnormalities. Its antioxidant properties further contribute to protecting the skin from oxidative damage. [9]

This review critically synthesizes the current body of scientific knowledge regarding the multifaceted contributions of various vitamins and minerals to the overall health, vitality, and aesthetic appearance of the skin, hair, and nails. A central theme emphasized throughout the review is the paramount importance of adhering to a balanced dietary regimen that provides an ample supply of essential micronutrients. Furthermore, the review explores potential correlations between documented deficiencies in specific micronutrients and the presentation of common dermatological conditions, thereby identifying key areas that warrant further investigation and highlighting opportunities for practical clinical application. [10]

Conclusion

Vitamins and minerals are essential for healthy skin, hair, and nails. Key nutrients like Vitamins A, C, D, E, biotin, zinc, iron, and selenium play crucial roles in processes such as antioxidant defense, collagen synthesis, cell growth, and hair follicle health. Deficiencies can lead to visible problems like brittle nails, hair loss, and skin conditions. Vitamin A regulates sebum and epidermal renewal. Vitamin C is vital for collagen and UV protection. Vitamin D impacts skin cell proliferation and immune function. Vitamin E protects against oxidative damage and UV rays. Biotin is essential for keratin production in hair and nails. Zinc supports cell division and wound healing. Iron is crucial for oxygen transport to hair follicles. Selenium acts as an antioxidant and is involved in hair growth regulation. Maintaining adequate micronutrient intake through a balanced diet is key to visible health, and understanding these roles can inform therapeutic strategies and future research.

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Conflict of Interest

None.

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