

Nutrition and Skin Aging

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Skin aging is a continuous process heavily determined by the combined influences arising from intrinsic aging, the environment and lifestyle factors including our diet. While it has long been understood that balanced nutrition is essential for maintaining healthy skin, and certain nutritional deficiencies result in skin abnormalities; increasing evidence suggests that what we eat can affect our skin aging appearance. Therefore it is not surprising that diet has been identified as a possible modifiable environmental risk factor for premature skin aging.

Introduction

It is generally agreed that certain individuals look “old for their age” or “young for their age”. Furthermore, appearance has been shown to be an indicator of overall health status and it has been shown that “looking old for your age” is associated with increased risk of mortality.¹ Skin aging is a continuous process heavily determined by the combined influences arising from intrinsic aging, the environment and lifestyle factors including our diet. Nutrition has an important role in the normal functioning of the skin and it is possible, in part, to diagnose a range of nutritional deficiencies from the general condition of skin. An increasing amount of evidence revealed in recent years highlights the potential effects of diet on skin aging. The majority of evidence relates to the ability of certain nutrients to protect skin from ultra violet radiation (UVR), but more recently studies have demonstrated direct physiological benefits of nutrients and the role of the diet on skin aging appearance. In this chapter, we highlight some of the key studies that describe the effects of nutrition and how a modified diet can prevent and/or improve skin aging and other aspects of skin condition.

Nutritional influences on skin health

Balanced nutrition is essential, not only to prevent chronic disease such as cardiovascular disease and certain cancers but also to maintain health and ensure normal functioning. Skin is constantly being regenerated and it contains tissues with high cell proliferation rates; therefore skin requires adequate amounts of protein, carbohydrate, oxygen and fats to fuel the high turnover of cells. Specific nutrients have important roles in the skin and the high dependency of skin on adequate nutrition is evidenced by the development of serious skin lesions in response to a variety of nutritional deficiencies.² Improving nutrition status generally reverses typical skin lesions and improves appearance.³ The diet also plays a beneficial role in skin disorders such as eczema, acne and psoriasis.⁴

Vitamins essential for skin function

The diet is an important source of several vitamins essential for the normal functioning of skin, including vitamins A, C, E and several of the B group vitamins. Vitamin A (retinol) has long been noted to be essential for skin function, with abnormal keratinization observed in vitamin A deficient animals.⁵ (For review see Miller, 1989.)⁶

Vitamin C is the predominant water soluble antioxidant vitamin in skin and required for the correct maturation and repair of connective tissues such as the dermal layer of skin.^{7,8} The effects of deficiency are well known partly because of its historical significance in relation to scurvy.

The B vitamins required for optimal skin health include riboflavin (vitamin B2), niacin (vitamin B3) and pyridoxine (vitamin B6). They are important in the maintenance of healthy skin through effects on cell renewal, DNA synthesis and in preventing oxidation of key cellular components.⁹⁻¹³

Vitamin E is also considered an important antioxidant that plays a role in skin antiaging and is included in many topical skin creams. Deficiency of vitamin E leads to an increase in lipid peroxidation in skin, a key mediator of oxidative damage highlighting its importance as a skin antioxidant. The vitamin works in conjunction with

vitamin C, glutathione, selenium and vitamin B3, which means that a diet high in vitamin E cannot have its optimal effect unless it is also rich in foods that provide these other nutrients.¹⁴

Evidence for the protective effect of diet on skin aging appearance

Sun exposure is one of the key causes of skin aging, giving rise to the characteristic onset of deep lines and wrinkles and sagging skin commonly termed photoaging. An increasing amount of evidence in recent years has highlighted the potential effects of diet on skin aging; particularly as a potential role for certain nutrient to provide systemic photoprotection. Most of the evidence is provided by supplement trials and two key epidemiological studies.

One recent observational study has examined the relation between dietary intake and skin aging appearance.¹⁵ In a cross-sectional study of 4025, middle-aged American women, higher intakes of vitamin C and linoleic acid and lower intakes of fats and carbohydrates were associated with better skin aging appearance. Skin aging was defined as the appearance of wrinkles, senile dryness (dryness as a result of skin aging) and skin atrophy (thinning). In these women, higher intakes of vitamin C were associated with a lower likelihood of a wrinkled appearance (OR 0.89; 95% CI: 0.82, 0.96) and senile dryness (OR: 0.93; 95% CICI: 0.87, 0.99). Higher linoleic acid intakes were associated with a lower likelihood of senile dryness (OR: 0.75; 95% CI: 0.64, 0.88) and skin atrophy (OR: 0.78; 95% CI 0.65, 0.95). A 17-g increase in fat and a 50-g increase in carbohydrate intakes increased the likelihood of a wrinkled appearance (OR: 1.28 and 1.36, respectively) and skin atrophy (OR: 1.37 and 1.33, respectively).

In support of these associations, previous studies have suggested that vitamin C may lower the prevalence of wrinkles and senile dryness by its actions as an antioxidant.¹⁶ Moreover, several studies have shown that vitamin C, in high doses, has photo protective properties through oral or topical applications¹⁷ and suggest improvements of wrinkles.¹⁸⁻¹⁹ The epidermis exhibits a highly active metabolism of polyunsaturated fatty acids (PUFA). The most abundant is linoleic acid (omega 6 fatty acid) which is considered essential for the skin,

due to the lack of functional delta 6-desaturase enzyme in skin. Deficiency results in characteristic scaly skin disorder and excessive epidermal water loss, due to its functional role in the maintenance of the epidermal water barrier, which could be important in its role in skin aging appearance.

The relation between nutrients and skin aging in this study was independent of age, sun exposure, race, menopausal status, energy intake, education, family income, BMI, supplement use, and physical activity. The favorable association of vitamin C and linoleic acid intake with skin aging may be attributable to the nutrients themselves or to the dietary sources of these nutrients; such as orange juice, citrus fruits, fruit juices and tomatoes for vitamin C and plant and seed oils are the main dietary sources of linoleic acid.

In terms of food intake, one other study described correlations between actinic skin damage in the sun-exposed site of 453 individuals of European descent and the types of food they consumed.²⁰ Dietary intake was assessed and skin measurements taken of Greek-born subjects living in Australia, Greeks living in rural Greece, Anglo-Celtic Australians and Swedes living in Sweden. After controlling for age and smoking, less actinic damage was associated with higher intake of vegetables, olive oil, fish and legumes. More actinic damage was associated with higher intakes of dairy foods, butter, margarine and sugar products. Amongst the Anglo-Celtic Australians, dried fruit, apples and tea accounted for 34% of the variance.

Both studies add to the diet and skin aging hypothesis by examining nutrient intakes from foods. However results from observational studies like these must be interpreted while considering some limitations. They are observational studies and do not draw conclusions about direct effects; more research is needed to understand these associations, including more randomized trials before conclusions can be drawn. It is important to note that the observations in these two studies may be attributable to the nutrients themselves; to the dietary sources of these nutrients; or to something else in these foods. The rest of the review will explore more specific nutrient supplement trials. Finally, the role of dietary vitamin C for example, in benefiting skin aging should be addressed by large randomized control trials.

Nutrient supplementation studies

As mentioned earlier, photoaging (skin aging due to sun exposure) is one of the key causes of skin aging; therefore the majority of existing evidence relating to skin benefits comes from supplemental trials and relates to the photoprotective benefits provided. Excessive exposure particularly acute episodes leading to sun burn are also linked to photocarcinogenesis. Accordingly excessive sun exposure is recognized as a health issue throughout life. In the United States about two thirds of the cumulative erythemal UV dose/year occurs inadvertently, when no topical sun protection is used and not during periods of intentional sunbathing.^{21,22} In addition, three quarters of lifetime sun exposure is delivered during adulthood and old age.²³ These factors argue strongly in favor of continual photoprotection throughout life.

The ability of a nutrient to provide systemic photoprotection requires it to have one or more of the following functions: prevent the absorption of UV light by skin, protect target molecules by acting as an antioxidant scavenger, induce cellular repair systems or suppress cellular responses such as inflammation. Some vitamins (e.g. C and E), carotenoids, minerals and n-3 polyunsaturated fatty acids have all been shown to provide photoprotective benefits and are believed to operate through one or more of the above mechanisms.

Carotenoids

Now convincing evidence has been collected from in vitro animal and human studies that carotenoids can afford an important degree of endogenous photoprotection and may therefore be presumed to help reduce skin photoaging. While the level of sun protection (SPF 2–4) is considerably lower than that afforded by topical sun creams, over a life time dietary photoprotection is still expected to contribute very significantly to overall improved skin appearance.

Carotenoids are plant pigments and function in the protection of the plant against excess light and are among the most efficient natural scavengers of singlet molecular oxygen.²⁴ The major carotenoids