Review Article

Nutrition and Skin Health in the Third Age

Leontaridou Ioanna
Professor of the Nutrition and Dietetics Department, International Hellenic University

Correspondence: Leontaridou Ioanna, Professor, International Hellenic University, Greece
Email: joanleont@gmail.com

Abstract

Introduction: Nutrition has been linked to skin health, including all possible aspects of skin health such as beauty, integrity as well as the aging process.
Aim: The aim of this review study is to investigate the impact of nutrition on the promotion of skin health in the elderly.
Methodology: An extensive review of the relevant literature was performed via electronic databases (Google Scholar, Pubmed, Medline, Scopus, the Hellenic Academic Libraries Association –HEAL link) and scientific journals (English and Greek) using specific key words.
Results: The nutritional deficiencies and inadequate nutrition due to aging will affect health and therefore skin. Adjusting and improving diet cannot only prevent the problems that occur in skin, but can certainly correct any potential underlying condition. Proper dietary intake acts complementary to endogenous factors in regulating the function of the skin barrier. Furthermore, vitamin deficiency affects skin health. Antioxidants such as carotenoids, tocopherols and flavonoids, as well as vitamins (A, C, D and E), essential omega-3 fatty acids, certain proteins and lactobacilli promote skin health and beauty.
Conclusions: Skin aging is a combination of endogenous physiological aging and environmental effects such. Proper nutrition contributes to reducing normal aging. A diet rich in antioxidants as well as vitamins protects the skin from l aging factors.

Key words: third age, skin, aging, nutrition, and vitamins

Introduction

The skin is the largest organ of the integumentary system and has a crucial role in keeping humans alive. This happens because the skin protects our delicate insides from the outside environment and helps regulate body temperature (Zaidi & Lanigan, 2010).

The skin clearly reflects the effects of ageing. Skin ageing is expected and is characterized by cellular damage and the reduced ability to regenerate our tissues. It is a complex biological process influenced by a combination of endogenous and exogenous factors (Ganceviciene et al., 2012).

Therefore, the health and appearance of the skin is related to lifestyle and eating habits, as well as critical age-related factors such as hormonal imbalance. Multiple processes in skin biology are associated with the onset and clinical course of several common skin conditions, such as acne, aging or even photoprotection (Pappas, Liakou & Zouboulis, 2016).

Nutrition and its reflection on the skin has always been an area of interest for health scientists. Nutrition has been linked for years to skin health, including all possible aspects of skin health such as beauty, integrity as well as the aging process. Foods containing a plethora of phytochemicals and antioxidants reduce oxidative stress and inflammation (Hoffman & Gerber, 2015). Additionally, monounsaturated fatty acids are associated with a lower risk of photo aging (Latreille et al., 2012).

The aim of this review study is to investigate the impact of nutrition on the promotion of skin health in the elderly.

The methodology followed was based on a literature search of reviews and research studies, which were retrieved from the international databases Medline, Pubmed, Scopus, Google Scholar Cinahl and the Hellenic Academic Libraries Association – HEAL link) and scientific journals (English and Greek) using specific

keywords: third age, skin, aging, nutrition, and vitamins. The exclusion criterion for the articles was language in addition to English and Greek.

Skin

The skin is the largest organ of the body, covering an area of 1.7 m^2 and weighing about 15% of the total body weight. The thickness, coloration and distribution of skin components vary in different parts of the body, depending on the function and needs of the area (Zaidi & Lanigan, 2010). It is a vital organ for human life because it has complex functions, among which the most important is the maintenance of homeostasis (Ribeiro, Leal & Jeunon, 2017).

The skin consists of three layers: the epidermis, dermis and hypodermis. The epidermis is the outer layer of the skin and consists mainly of keratinocytes, whose main function is to synthesize keratin. The dermis is the middle layer of the skin and is located in the fat cell lobules (Fodor, Ullmann & Elman, 2011). It is mainly composed of collagen and elastin and functions as the connective tissue of the epidermis and subcutaneous tissue. The hypodermis is both a fat complex and the seat of the larger blood vessels. It is the deepest layer of skin and contains adipose lobules along with some skin appendages like the hair follicles, sensory neurons, and blood vessels. (Yousef, Alhajj & Sharma, 2022). It is the point of vascular interaction between hair follicles and sweat glands (Silverberg, 2012).

The components of the skin are the hair, nails, sebaceous glands and sweat glands, which are divided into secretory and excretory glands. These components originate from the epidermis during intrauterine life. In addition, all of the above except the nails are found in the dermis (Zaidi & Lanigan, 2010).

Aging of the Skin

Skin aging is a complex biological process influenced by a combination of endogenous (genes, cellular metabolism, hormones, metabolic processes) and exogenous (chronic light exposure, pollution, ionizing radiation, chemicals, toxins) factors (Ganceviciene et al., 2012). Skin aging is characterized by features such as wrinkling, loss of elasticity, laxity, and the appearance of a rough texture. This aging process is accompanied with phenotypic changes in skin cells as well as structural and functional changes in the components of the extracellular matrix such as collagens and elastin (Zhang & Duan, 2018).

Aging contributes to the progressive loss of structural integrity and normal skin processes. Therefore, cell regeneration is continuously decreased, barrier function and mechanical protection are degraded, immune responses and wound healing are delayed, thermoregulation, as well as sweat and sebum production, is reduced (Kourkouta et al., 2016). The content of natural hydration factors and lipids in the stratum corneum is also reduced, leading to a lower water retention capacity. Thus, older people often suffer from dry skin. A decrease in collagen production is also significant (Wiegand, Raschke & Elsner, 2017). Collagen is considered vital for skin health because both photo-aging and intrinsic aging reduce its presence in the body (Cho, Yoo & Seo, 2018). This, in turn, causes a decrease in skin thickness, as well as a loss of elasticity and flexibility (McCabe et al, 2020).

One of the most remarkable features of skin aging is how different the appearance of the skin is between people of the same age. While some individuals show pronounced wrinkles and hyperpigmentation, others show fine wrinkles but pronounced sagging and hypopigmentation of the skin. This difference between individuals is due to environmental and genetic factors that can affect the way skin aging occurs (Gunn, 2017).

There are two main types of skin aging. In exposed areas of the body, aging is mainly caused by exogenous factors such as UV radiation and smoking. In protected areas of the skin, endogenous factors such as genetic predisposition and changes in the endocrine environment play a notable role (Kanaki, Makradonaki & Zouboulis, 2016). Aging due to endogenous factors is also referred to as biological aging, while aging due to exogenous factors is referred to as environmental aging (Krutmann, 2011).

Biological aging is the result of a combination of several processes, such as a reduction in the ability to repair cellular DNA, loss of telomeres with age, cellular aging and reduced proliferative capacity. In addition, mutations in extra-nuclear mitochondrial DNA (mtDNA) loci, potentially leading to increased oxidative stress, as well as the increased frequency of chromosomal abnormalities, are only some of the theories of the pathophysiology of aging (Kanaki, Makradonaki & Zouboulis, 2016).

Environmental aging depends on self-protection and can be prevented. Factors such as smoking, poor diet and exposure to sunlight are the main causes of exogenous, premature skin ageing. Exposure to solar radiation is also referred to as photoaging (Baumann, Weisberg & Percival, 2009). Air pollution, stress and poor sleep habits also affect aging (Gunn & Christensen, 2017). Therefore, environmental skin aging can be prevented by a combination of dietary strategies and the use of sunscreen and other cosmetics (Krutmann, 2011).

Nutrition and Aging

Multiple processes in skin biology are associated with the onset and clinical course of several common skin conditions, such as aging and photoprotection (Pappas, Liakou & Zouboulis, 2016).

Proper dietary intake acts complementary to endogenous factors in regulating the function of the skin barrier. Poor nutritional status can alter the structural and biological function of the skin, causing skin abnormalities such as dry skin (Park, 2015).

Malnutrition as well as excessive food intake can damage the physiology of the skin. For example, in obese individuals there is a significant loss of transdermal water, which suggests an alteration in the function of the skin barrier. In addition, obesity can affect sebum production, contribute to changes in micro- and macrocirculation and alter collagen metabolism (Piccardi & Manissier, 2009; Iliadis et al, 2016).

Furthermore, vitamin deficiency affects skin health. Vitamins, as antioxidant defense components of the skin, are mainly obtained from food, so the vitamin content in the diet is closely related to the antioxidant capacity of the skin and the physiological functions (Evans & Lawrenson, 2017; Cao, 2020.) Antioxidants such as carotenoids, tocopherols and flavonoids, as well as vitamins (A, C, D and E), essential omega-3 fatty acids, certain proteins and lactobacilli promote skin health and beauty (Schagen et al., 2012).

The vitamins of great importance for maintaining skin integrity are A, C, D and E (Raj et al., 2017). Through the action of vitamin A, faster regeneration and wound healing is achieved (Park, 2015). Its derivatives, retinoids (from animals) and carotenoids (from plants) play an important role in regulating cell proliferation, apoptosis and cell differentiation, including skin cells (Raj et al., 2017).

Vitamin C is a powerful antioxidant that reduces the damage caused to the skin by UV radiation. It significantly suppresses the production of free radicals from UV radiation, protecting cells from oxidative stress. At the same time, it increases the moisture content of the skin, improving skin hydration. In addition, by increasing collagen synthesis, the skin barrier is strengthened and wound healing is achieved (Park, 2015).

Vitamin D is a remarkable factor in skin health, as it maintains the bone architecture on which the skin is built. (Griffith et al., 2016). Vitamin D plays a key role in preventing problems associated with skin aging as it synthesizes the skin (Draelos, 2010). In addition, vitamin D enhances skin protection against aging by inhibiting the breakdown of polly-ADP-ribose polymerase, a key DNA repair enzyme, while stimulating the synthesis of metalloethionine, an antioxidant (Raj et al., 2017).

Vitamin E has multiple actions. It acts in synergy with vitamin C and demonstrates its antioxidant properties in the presence of vitamin C (Draelos, 2010). In particular, it enhances collagen synthesis, reduces collagenase concentration and plays an important role in apoptosis and the regulation of the immune response (Raj et al., 2017). Vitamin E also protects the skin from the negative effects of environmental aging factors, such as chemicals, pollutants and solar radiation, by inhibiting the spread of free radicals (Cassano, 2012).

Deficiencies of vitamins A, C and E, riboflavin, niacin, pyridoxine, zinc, selenium and certain essential fatty acids and/or amino acids have been shown to cause skin and hair damage. Although the prevalence of nutritional deficiencies is low in the western world, unbalanced and inadequate nutrition due to disease, aging and chemical abuse will affect health and therefore skin. Adjusting and improving diet can not only prevent the problems that occur in skin and hair, but can certainly correct any potential underlying condition (Pappas, Liakou & Zouboulis, 2016).

Anti-Aging Foods

Human skin is particularly exposed to oxidative stress. The skin is also exposed to various external environmental factors, such as exposure to

ultraviolet radiation, ozone and chemical pollutants. If a cell's antioxidant levels are low or its antioxidant enzymes are blocked, oxidative stress can cause the cell to become damaged (Ogunro, Fakayode & Batiha, 2022). Therefore, cellular antioxidant mechanisms are critical to prevent structural damage and mutations. They prevent the oxidation of biological molecules, reducing the formation of free radicals or destroying the already existing active form of oxygen.

Carotenoids are derivatives of vitamin A with excellent antioxidant properties and photoprotective activity (Schagen et al., 2012). They protect the skin from UV radiation as well as from oxidative mechanisms (Pandel et al., 2013). The most important carotenoids are beta-carotene. Compared to other carotenoids, its primary role is the action of provitamin A (Draelos, 2010). Beta-carotene has emerged as a photoprotective component of the skin.

In addition, it has been shown to affect wrinkling and skin elasticity and UV-induced damage to human skin (Pandel et al., 2013). Sources of beta-carotene include carrots, pumpkin, sweet potatoes, mango and papaya (Draelos, 2010).

Polyphenols have strong antioxidant properties and most of the studies demonstrate their potential role in the prevention of various diseases related to oxidative stress. They are mostly found in fruits and plant derivatives such as fruit juices, tea, coffee and red wine. Vegetables, cereals, chocolate and legumes are also important sources of polyphenols (Schagen et al., 2012). Hippophae species plants have also high polyphenolic content and are widely used in food, medicine, or cosmetics. The main polyphenols in Hippophae species are flavonoids, phenolic acids and tannins, which have multiple effect (Ji, 2020).

Resveratrol is an antioxidant that belongs to the polyphenols. It is found in high concentrations in grapes, red wine, walnuts and certain berries. Resveratrol has been the subject of intensive research and is reported to be a powerful health antioxidant as it regulates gene expression (Manela-Azulay et al., 2017).

Green tea has many properties, the most important of which are antioxidant, anti-inflammatory and anti-cancer properties (Draelos, 2010). The use of green tea extract would be useful to avoid the adverse effects of solar radiation, as it reduces DNA damage that occurs after exposure to UV radiation (Manela-Azulay et al., 2017).

Pomegranate contains several bioactive compound categories such as flavonoids, tannins, lipids, simple organic acids and alkaloids. Flavonoids are generally present in pomegranate in glycosylated forms and they possess strong antioxidant and anti-inflammatory properties as well as anti-cancer properties (Afaq & Mukhtar, 2011; Stefanou et al, 2020). Consumption of pomegranate juice meets a percentage of the body's daily requirements of vitamin C. At the same time, pomegranate protects skin fibroblasts from cellular damage caused by ultraviolet radiation as well as reduces oxidative stress (Drailos, 2010). Pomegranate contains several categories of bioactive compounds such as flavonoids, tannins, lipids, simple organic acids and alkaloids.

Grape seed extracts contain polyphenolic proanthocyanidins and procyanidins, which have a strong antioxidant capacity. They exhibit a broad spectrum of pharmacological properties against oxidative stress. A remarkable property of this extract is the facilitation of healing, the regeneration of skin wounds and the protection of collagen and elastin from damage and degradation. It is widely used in anti-aging and skin whitening cosmetics because it prevents the action of tyrosinase (Wu et al., 2012; Ma & Zhang, 2017).

Coffeeberry is an antioxidant collected from the fruit of the Coffee arabica plant and contains powerful polyphenols such as chlorogenic acid, concentrated proanthocyanidins, quinic acid and ferulic acid. It has been shown to regulate the expression of collagen in advance and mitigate the expression of metalloproteinases. This results in the improvement of fine lines, wrinkles and skin tone (Manela-Azulay et al., 2017).

Ginkgo biloba contains flavonoids not found in other herbs. The leaves of the plant contain unique polyphenols, such as terpenoids, flavonoids and flavonoid glycosides, which have anti-inflammatory properties. These components act against free radicals and lipid peroxidation in the fibroblasts of the experiments. In addition, flavonoids of biloba ginkgo cause proliferation of human skin fibroblasts and increase in collagen (Draelos, 2010).

Curcumin is a pigment used to colour pre-packaged snacks and even meats; it has a variety of biological properties and its administration in high doses does not cause toxicity. Curcumin has been shown to attenuate oxidative stress and suppress inflammation. Thus, it becomes clear that its contribution to anti-ageing is significant (Schagen et al., 2012).

Probiotics also support skin homeostasis, synthesize the structural and functional components of the skin, strengthen the immune system and help fight the inflammatory response (Raj et al., 2017).

Conclusion: Skin aging is a combination of endogenous physiological aging and environmental effects such as sun, pollution and air. Proper nutrition contributes to a certain extent to reducing normal aging, but does not protect against external environmental factors.

A diet rich in antioxidants such as carotenoids, polyphenols, ubiquinone, etc. as well as vitamins A, C, D and E prevents the skin aging process and protects the skin from environmental aging factors.

References

Afaq F., Mukhtar H. (2011). Botanical Antioxidants for Skin Protection: An Overview. In: Krutmann J. & Humbert P. (Editors). Nutrition for Healthy Skin. Springer Berlin, Heidelberg, 51-63

Baumann L., Weisberg E., Percival S. L. (2009). Skin Aging and Microbiology. In: Percival S. L. (Editors). Microbiology and Aging: clinical manifestations. Humana Press, NY, USA, 57-94.

Cao C., Xiao Z., Wu Y., Ge C. (2020). Diet and Skin Aging-From the Perspective of Food Nutrition. Nutrients, 24; 12(3), 870

Cassano R. (2012). Vitamin E chemistry, biological activity and benefits on the skin. In: Preedy V.R. (Editors). Handbook of diet, nutrition and the skin. Human Health Handbooks 1 (2). The Netherlands: Wageningen Academic Publishers, 144-163

Cho B.A., Yoo S.-K., Seo J.-S. (2018). Signatures of photo-aging and intrinsic aging in skin were revealed by transcriptome network analysis. Aging (Albany NY), 10(7), 1609–1626.

Draelos Z. D. (2010). Nutrition and enhancing youthful-appearing skin. Clin Dermatol, 28(4), 400-408

Evans J.R. & Lawrenson J.G. (2017). Antioxidant vitamin and mineral supplements for slowing the progression of age-related macular degeneration. Cochrane Database Syst. Rev.

Fodor L., Ullmann Y., Elman M. (2011). Skin Anatomy. In: Aesthetic Applications of Intense Pulsed Light. London: Springer, 1-10

Ganceviciene R., Liakou A. I., Theodoridis A., Makrantonaki E., Zouboulis C. C. (2012). Skin anti-aging strategies. Dermato-Endocrinology, 4(3), 308–319

Griffith J. L., Al-Jamal M., Lim H. W. (2016). Photoprotection and Vitamin D. In: Wang S.Q., Lim H.W. (Editors). Principles and Practice of Photoprotection. Adis. Springer International Publishing, Switzerland, 95-104

Gunn D.A., Christensen K. (2017). Skin Aging and Health. In: Farage M., Miller K., Maibach H. (Editors). Textbook of Aging Skin. Berlin, Heidelberg: Springer, 551-562

Gunn D.A. (2017). The Genetics of Skin Aging. In: Farage M., Miller K., Maibach H. (Editors). Textbook of Aging Skin. Berlin, Heidelberg: Springer, 1-14

Hoffman R, Gerber M. (2015) Food Processing and the Mediterranean Diet. Nutrients 2015, 7(9), 7925–7964

Iliadis C., Mihalache A., Monios A., Dimitriadou A. (2016). Malnutrition and obesity in third age J. Healthc. Commun, 1 (3), 1-4

Ji M., Gong X., Li X., Wang C., Li M. (2020). Advanced Research on the Antioxidant Activity and Mechanism of Polyphenols from Hippophae Species—A Review. Molecules, 25(4), 917

Kanaki T., Makrantonaki E., Zouboulis C. C. (2016). Biomarkers of skin aging. Rev Endocr Metab Disord, 17(3), 433-442

Kourkouta L., Frantzana E., Iliadis C., Monios A. (2016) Health Problems of the Elderly. Monograph. Scholar's Press. Saarbrucken, Germany

Krutmann J. (2011). Skin Aging. In: Krutmann J., Humbert P. (Editors). Nutrition for Healthy Skin. Berlin, Heidelberg: Springer, 15-24

Latreille J., Kesse-Guyot E., Malvy D., Andreeva V., Galan P., Tschachler E., Hercberg S., Guinot C., Ezzedine K. (2012). Dietary monounsaturated fatty acids intake and risk of skin photoaging. PLoS One, 7(9), e44490

Ma Z.F., Zhang H. (2017) Phytochemical Constituents, Health Benefits, and Industrial Applications of Grape Seeds: A Mini-Review. Antioxidants, 6(3), 71

Manela-Azulay M., Azulay V., Aguinaga F., Claudia M., Issa A. (2017). Vitamins and Other Antioxidants. In: Issa M, Tamura B (Editors). Daily Routine in Cosmetic Dermatology. Clinical Approaches and Procedures in Cosmetic Dermatology, 1. Cham: Springer, 181-194

McCabe M.C., Hill R.C., Calderone K., Cui Y., Yan Y., Quan T., Fisher G.J., Hansen K.C. (2020). Alterations in extracellular matrix composition

during aging and photoaging of the skin. Matrix Biol Plus, 17(8), 100041

Ogunro, O. B., Fakayode, A. E., & Batiha, G. E. (2022). Involvement of Antioxidant in the Prevention of Cellular Damage. In A. P. S. Sabuncuoglu, & A. Yalcinkaya (Editors), Importance of Oxidative Stress and Antioxidant System in Health and Disease [Working Title]. IntechOpen. https://doi.org/10.5772/intechopen.108732

Pandel R., Poljšak B., Godic A., Dahmane R. (2013). Skin Photoaging and the Role of Antioxidants in Its Prevention. ISRN Dermatology, 930164

Pappas A., Liakou A., Zouboulis C.C. (2016). Nutrition and skin. Rev Endocr Metab Disord, 17(3), 443-448

Park K. (2015). Role of micronutrients in skin health and function. Biomol Ther, 23(3), 207-217

Piccardi N. & Manissier P. (2009). Nutrition and nutritional supplementation: Impact on skin health and beauty. Dermatoendocrinol, 1(5), 271-274

Raj U. L., Sharma G., Dang S., Gupta S., Gabrani R. (2017). Impact of Dietary Supplements on Skin Aging. In: Farage M., Miller K., Maibach H. (Editors). Textbook of Aging Skin. Berlin, Heidelberg: Springer, 578-591

Ribeiro C. S., Leal F., Jeunon T. (2017). Skin Anatomy, Histology, and Physiology. In: Issa M., Tamura B. (Editors). Daily Routine in Cosmetic Dermatology. Clinical Approaches and Procedures in Cosmetic Dermatology, 1. Cham: Springer, 3-14

Rittié L. & Fisher G. J. (2015). Natural and sun-induced aging of human skin. Cold Spring Harb Perspect Med, 5(1), 1-14

Schagen. K., Zampeli V. A., Makrantonaki E., Zouboulis C. C. (2012). Discovering the link between nutrition and skin aging. Dermato-Endocrinology, 4(3), 298–307

Silverberg N.B. (2012). The skin: an introduction. In: Preedy V.R. (Editors). Handbook of diet, nutrition and the skin. Human Health Handbooks 1(2). The Netherlands: Wageningen Academic Publishers, 12-23

Stefanou, V., Papatheodorou, S., Tsakni, A., Lougovois, V., Talelli, A., Panourgias, G., & Tsaknis, I. (2020). Anti-Inflammatory Properties of Pomegranate. International Journal of Advanced Research in Microbiology and Immunology, 2(1), 1-13

Yousef H., Alhajj M., Sharma S. (2022). Anatomy, Skin (Integument), Epidermis. [Updated 2022 Nov 14]. In: StatPearls [Internet]. Treasure Island (FL): Stat Pearls Publishing; 2022 Jan. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470464/

Wiegand C., Raschke C., Elsner P. (2017). Skin Aging: A Brief Summary of Characteristic Changes. In: Farage M., Miller K., Maibach H. (Editors). Textbook of Aging Skin. Berlin, Heidelberg: Springer, 55-65

Zaidi Z. & Lanigan S. W. (2010). Skin: Structure and Function. In: Laningan S.W. & Zaidi Z. (Editors) Dermatology in Clinical Practice. Springer, London, UK, 1-15

Zhang S & Duan E. (2018). Fighting against Skin Aging: The Way from Bench to Bedside. Cell Transplant. 27(5):729-738

Wu Y., Chen H. –D., Li Y.-H., Gao X.-H., Preedy V. R. (2012) Antioxidants and skin: an overview. In: Preedy V. R. (Editors). Handbook of diet, nutrition and the skin. Human Health Handbooks 1(2). The Netherlands: Wageningen Academic Publishers, 68-90