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The Role of Physical Activity in Enhancing and Preserving Skin Health

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Abstract

Introduction:

Interest in the relationship between physical activity and skin health has grown significantly in recent years. Both scientific literature and media platforms highlight the influence of exercise on skin vitality, with social media often emphasizing its aesthetic benefits. Scientific studies, however, focus on mechanisms like improved circulation, enhanced collagen production, and reduced inflammation. This review aims to analyze the impact of physical activity on skin health, examining its benefits and potential drawbacks while providing a comprehensive understanding of the biological processes involved.

Aim of the study:

The study seeks to review scientific literature to evaluate the effects of physical exercise on skin health and condition.

Materials and methods:

The authors conducted a review of scientific literature using databases such as PubMed, ScienceDirect, UpToDate, and Google Scholar. Articles from 2003 to 2024 were analyzed

with keywords including physical activity and skin health, exercise and dermatology, skin metabolism, and exercise benefits for the skin. Only studies relevant to the relationship between physical activity and skin health were included.

Results and conclusions:

Physical activity significantly benefits skin health by boosting collagen production, improving circulation, and reducing cortisol levels, resulting in a radiant and youthful complexion. However, risks such as barrier damage, increased sebum production, and infections must be managed. Personalized skincare routines emphasizing cleansing, hydration, and protection against environmental factors are essential for individuals engaging in regular exercise.

Keywords: physical activity, skin health, exercise, dermatology, skin metabolism, aging.

Introduction

Exploring the impact of physical activity on skin health and condition is a topic that deserves particular attention, both from a medical perspective and in the context of everyday skincare practices. The growing interest in health, physical fitness, conscious nutrition, and the promotion of a healthy lifestyle that enhances well-being and prolongs life has inspired the authors to delve into the effects of physical activity on skin condition and function. As the largest organ of the human body, the skin plays a crucial role not only in aesthetics but also in protective functions and overall well-being. Understanding how physical exercise influences the skin can benefit individuals and professionals specializing in skin health and care.

The skin reflects the internal health of the body, with changes in circulation, metabolism, or hormone levels often mirrored in its appearance. Investigating this relationship could lead to the development of more effective skincare and therapeutic methods that consider physical activity as a vital component of supporting skin health.

The increasing number of people actively participating in sports creates a need for dermatologists and skincare specialists to provide tailored recommendations that address the specific needs of physically active individuals. Physical activity has both positive and negative impacts on the skin. On the positive side, it improves circulation and tissue oxygenation, promoting skin regeneration and delaying aging processes. (1–4) Conversely,

excessive friction, intense sweating, or exposure to UV radiation during outdoor exercises can cause irritation, compromise the skin barrier, or increase the risk of skin cancer. (5–7) Research in this area provides a scientific basis for creating skin protection protocols for active individuals.

Healthy skin contributes to self-esteem and overall quality of life. Regular physical activity is well-known for enhancing mental well-being by reducing stress and lowering cortisol levels, which positively affects the skin by minimizing inflammation and conditions such as acne.(8) Expanding knowledge of these relationships can encourage healthy habits and motivate more individuals to incorporate physical activity into their self-care routines.

The study of the impact of physical activity on the skin is relatively new, offering tremendous potential for further research. Emerging investigative methods, such as skin capacitance mapping and advanced biochemical analyses, allow for a deeper understanding of the mechanisms through which exercise influences various aspects of skin health. The findings of such research could have applications in both medicine and the cosmetics industry.

Promoting knowledge about the benefits and challenges of physical activity for skin health can raise public awareness of the importance of proper skincare for active individuals. Education in this area might include topics such as the significance of sun protection, proper post-exercise cleansing routines, and the use of products that support skin barrier regeneration.

Exercise's Impact on Sweat Gland Activity and Skin Health

Sweat glands are indispensable for thermoregulation, hydration, and the maintenance of the skin barrier.(9) It is evident that physical activity has a considerable impact on the activity of these glands, resulting in enhanced sweat production and improved skin hydration. The study of the effects of exercise on sweat gland function has yielded valuable insights into the manner in which physical activity affects the skin's physiological responses.

During mild physical exercise, the sweat glands are progressively activated, initially producing sweat vapor, which is followed by the appearance of visible liquid sweat as the activity continues. This augmented production of sweat enhances dermal hydration, thereby improving dermal moisturization. However, as the production of sweat increases, the temperature of the skin also rises, reflecting the thermoregulatory effects of exercise.(10)

Research on exercise-induced sweating further emphasizes the importance of physical activity in skin hydration and overall skin condition. Regular exercise increases sweat production, which temporarily hydrates the skin’s outer layers, helping maintain moisture balance. In addition to this, enhanced circulation from exercise helps reduce oxidative stress, a key factor

in skin aging, thus promoting a healthier and more youthful appearance. This effect not only supports skin hydration but also plays a role in reducing the visible signs of aging and improving skin vitality.(11)

Furthermore, the impact of exercise on skin hydration is evident, as active individuals demonstrate superior hydration in the stratum corneum, thereby preventing dry skin. While transepidermal water loss (TEWL) remains unchanged, regular physical activity helps maintain optimal hydration levels, contributing to healthier, better-hydrated skin.(6)

These findings underscore the importance of physical activity not only for thermoregulation but also for supporting skin health and hydration. Regular exercise, through its effects on sweat gland activity and enhanced circulation, provides significant benefits to skin hydration, moisture balance, and overall appearance.

How Exercise Shapes Skin Barrier Function

The skin barrier, which is primarily located in the stratum corneum, plays a vital role in protecting the body from environmental stressors, maintaining hydration, and regulating pH. (11) It is evident that physical activity, particularly endurance and high-intensity exercises, exerts a profound impact on the functionality of the skin barrier through processes such as sweating and alterations in skin physiology.

It has been demonstrated that exercise has a marked effect on dermal hydration. For example, the hydration levels in the stratum corneum increased by over 50% (51.9% at the forearm and 31.9% at the chest) following moderate-intensity exercise, indicating that sweating temporarily enhances the skin's capacity to retain moisture. However, exercise also results in a reduction in sebum content, with levels declining significantly during the course of the activity. Sebum plays a pivotal role in maintaining the lipid stability of the skin barrier; its loss can render the skin more susceptible to damage.(12)

The fluctuations in sweat production and pH levels that occur during exercise have a marked effect on the physiology of the skin. The physical exertion often observed in exercise can result in an increase in skin pH, which disrupts the natural acidic environment of the skin. This can have an adverse effect on the integrity of the skin's barrier and the balance of the skin's microbiota. Although pH levels typically return to baseline post-exercise, these changes underscore the necessity for skincare regimens that facilitate recovery. The initial effect of sweating is to boost the levels of hydration and sebum production in the skin. However, prolonged or intense sweating may result in a depletion of essential lipids, which could potentially lead to a stress response in the skin barrier. In order to counteract these effects,

post-exercise skincare should include moisturizing products to retain hydration, cleansers to manage oil levels, and pH-balanced solutions to restore acidity. It is imperative that those who engage in regular physical activity implement tailored skincare routines in order to minimize challenges and maximize benefits for skin health..(11,13)

The Role of Exercise in Supporting Collagen Health

Collagen is a fundamental component of the skin, playing a pivotal role in its structural integrity, elasticity, and resilience. Its continuous remodeling is influenced by various factors, including physical activity. The results of studies indicate that both impact and non-impact exercises have a significant effect on collagen turnover and skin mechanics, offering valuable insights into the maintenance of skin health.(14)

The findings of research studies indicate that impact exercises, such as running, and non-impact activities, like deep water running, influence collagen remodeling by altering the antigenicity of type IV collagen. The reduction in serum collagen IV levels following both activities indicates a decrease in synthesis rather than an increase in degradation. The effect was more pronounced in impact exercises, indicating that mechanical stress enhances collagen turnover, whereas non-impact exercises appear to rely more on metabolic factors. This finding challenges the assumption that only high-impact activities stimulate collagen remodeling, indicating that low-impact exercises may also be effective in maintaining connective tissue health without excessive strain.(14)

Further studies on the mechanical properties of the skin demonstrate a positive correlation between moderate-to-vigorous physical activity and improved skin elasticity, as indicated by increased maximal deformation. Conversely, a reduction in viscoelasticity indicates an improvement in structural resilience. In contrast, light activities, such as warm-ups, had no significant impact on collagen-related properties, thereby emphasizing the importance of exercise intensity in promoting collagen synthesis and skin elasticity.(15)

These findings demonstrate that regular exercise is beneficial for collagen health by maintaining a balance between synthesis and turnover, which in turn improves skin elasticity and structural integrity. Both impact and non-impact activities are of significant importance, offering flexibility in the design of exercise regimens that are tailored to the individual's needs. The incorporation of moderate-to-vigorous exercise into daily routines allows individuals to promote collagen health, which in turn enhances skin resilience and overall appearance.(14,15)

Defying Skin Aging Through Exercise

The process of skin aging is the result of a complex interplay between intrinsic and extrinsic factors. Intrinsic factors include biological aging, while extrinsic influences encompass UV radiation, oxidative stress, and lifestyle choices. It has been demonstrated that physical activity can be an effective, non-invasive method to slow the aging process. This is achieved by improving skin elasticity, boosting collagen production, and enhancing overall skin health. A number of key studies have provided valuable insights into the manner in which exercise can mitigate the effects of ageing on the skin.

The findings of research studies indicate that regular physical activity has a significant beneficial effect on skin hydration and barrier function. Individuals with higher levels of physical activity demonstrate enhanced stratum corneum hydration, which serves to protect against the development of dryness, a condition that is typical of aged skin. It can be concluded that exercise plays a vital role in maintaining the skin's ability to retain moisture, which is crucial for a youthful appearance.(16)

Long-term aerobic and resistance training have been demonstrated to enhance dermal thickness and elasticity, thereby directly counteracting the thinning and sagging associated with the aging process. In particular, resistance training has been demonstrated to support the production of structural components, such as biglycan, while simultaneously reducing inflammatory markers associated with skin ageing. This dual effect, whereby exercise exerts a beneficial influence on both structural enhancement and inflammatory reduction, highlights the role of physical activity in preserving skin integrity.(4)

Furthermore, physical activity has been shown to positively influence biomarkers related to the extracellular matrix, thereby improving skin hydration and reducing oxidative stress. These changes contribute to the development of healthier, more resilient skin, which is better equipped to withstand the cumulative effects of time and environmental stressors.(17)

Furthermore, high-intensity exercise has been demonstrated to promote dermal regeneration by enhancing mitochondrial function and collagen production. Elevated levels of mitochondrial DNA and interleukin-15 (IL-15), regulated through AMPK (AMP-activated protein kinase) activation, have been linked to improved skin metabolism and vitality. This molecular pathway elucidates the manner in which exercise directly combats the cellular mechanisms of aging.(3)

In conclusion, it can be stated that regular exercise, in particular resistance and high-intensity training, represents a highly effective method for postponing the ageing process of the skin. By reducing inflammation, oxidative stress, and supporting essential skin structures, physical

activity offers a comprehensive strategy for maintaining skin health. (13) The combination of regular exercise and targeted skincare represents an effective strategy for combating the visible and cellular effects of ageing.

The correlation between exercise, cortisol regulation and dermal wellbeing

Cortisol, the body's primary stress hormone, plays a pivotal role in regulating a multitude of physiological functions, including metabolism, inflammation, and the integrity of the skin barrier. Elevated cortisol levels, frequently precipitated by chronic stress, have been demonstrated to contribute to a range of dermatological conditions, including acne, xerosis (dryness) and impaired barrier function. (8) It has been demonstrated that physical activity, particularly aerobic exercise, has the capacity to modulate cortisol levels, thereby exerting a beneficial influence on dermal health.

A 12-week study on the effects of aerobic exercise on cortisol levels revealed a statistically significant reduction in serum cortisol levels, from an average of 142.98 to 106.88. The reduction in cortisol levels was also found to correlate with a notable improvement in the participants' perceived stress levels, as reported on the Perceived Stress Scale. A decrease in cortisol and stress levels is associated with an improvement in skin barrier function, a reduction in inflammation, and an overall enhancement in the condition of the skin, including the resolution of conditions such as psoriasis and acne. This finding highlights the beneficial effects of regular exercise in the management of stress-related dermatological conditions.(18)

Further research has demonstrated that elevated cortisol levels disrupt tight junctions (TJs) in keratinocytes, the skin's protective cells. These TJs are essential for maintaining the skin barrier, and their breakdown leads to increased skin permeability and compromised barrier function. The study revealed that cortisol reduced the mRNA and protein expression of key TJ components, including claudin-1, claudin-3, and ZO-1. This disruption contributes to conditions like dry skin and loss of elasticity, but exercise, by lowering cortisol, can help preserve the skin's barrier integrity.(19)

Furthermore, cortisol has been shown to influence sebum production, as evidenced by research conducted on the sebaceous glands of the skin. The hormone stimulates the production of lipids in sebocytes through corticotropin-releasing hormone (CRH), which is essential for maintaining dermal hydration and protection. However, excessive cortisol-driven lipid production can result in the development of acne and other dermatological disorders. The beneficial effects of exercise on cortisol levels contribute to the normalization of sebum production, which in turn fosters healthier skin.(8)

Regular physical activity, particularly aerobic exercise, has been demonstrated to be an effective strategy for lowering cortisol levels, which in turn improves skin barrier function, reduces inflammation, and supports overall skin health. It is recommended that exercise be regarded as an indispensable element of skincare routines and stress management strategies, in order to maintain healthy and resilient skin.(8,18,19)

Exercise's Impact on Circulatory Function and Skin Health

It is widely acknowledged that physical exercise, particularly aerobic and resistance training, plays a pivotal role in optimizing circulatory function, which in turn confers significant benefits to skin health. The benefits of exercise for the skin include improvements in blood flow, tissue oxygenation, and nutrient delivery, which support the regeneration, elasticity, and resilience of the skin in the face of ageing and environmental stressors.(20)

One study examined the impact of aerobic and resistance exercise on vascular function in individuals with insulin resistance. The findings demonstrated that regular exercise markedly enhanced vascular function, which is pivotal for sustaining optimal dermal health. Enhanced circulation ensures the delivery of oxygen and nutrients to the skin while promoting the removal of toxins, which improves the appearance of the skin. The combination of aerobic and resistance training was found to be particularly efficacious in improving vascular health and insulin sensitivity, thereby reducing the risk of skin issues linked to metabolic conditions.(21)

Another study investigated the impact of high-intensity interval training (HIIT) and high-volume training (HVT) on swimming performance and aerobic capacity. The HIIT group demonstrated notable enhancements in VO2peak and endurance, indicative of augmented circulatory performance. This expansion in aerobic capacity was correlated with elevated skin regeneration, as superior circulation facilitates the delivery of oxygen and nutrients to the skin, thereby fostering more resilient and healthy skin.(22)

Additionally, a study on patients with stable coronary artery disease (CAD) assessed the impact of regular physical training on endothelial function and the expression of endothelial nitric oxide synthase (eNOS) in the left internal mammary artery (LIMA). After four weeks of aerobic exercise, the training group showed a 56% increase in endothelium-dependent vasodilation, accompanied by a significant increase in eNOS expression and phosphorylation. These changes resulted in improved vascular function, which also enhanced circulation and oxygenation of the skin. The findings suggest that regular exercise improves endothelial

function and nitric oxide production, supporting better skin health and appearance by promoting better circulation.(23)

In conclusion, exercise markedly enhances circulatory function, which directly supports skin health. Regular physical activity augments oxygen delivery, nutrient supply, and toxin removal, thereby promoting the maintenance of youthful and healthy skin. Exercise not only benefits cardiovascular health but also contributes to improved skin vitality, emphasizing the importance of physical activity as part of a holistic approach to maintaining both overall and dermatological health.(1)

Exercise and Skin Health: Infections, Inflammation, and Oxidative Stress

While physical activity confers numerous benefits to health, it also presents certain risks to the skin, particularly in terms of increased susceptibility to infections and inflammation. (24) The impact of exercise on dermatological conditions, including infections, inflammatory processes and oxidative stress, has been the subject of numerous investigations, which have revealed both beneficial and detrimental effects of physical exertion on the skin.

One of the primary concerns for athletes and those engaging in intense physical activities is the heightened risk of developing skin infections. The proximity of physical contact, the sharing of sports equipment, and the exposure to communal environments such as gyms and swimming pools facilitate the transmission of bacteria and fungi, thereby increasing the susceptibility of athletes to skin infections. (25)

A study of wrestlers, for instance, revealed that they experienced skin infections at a rate 9.5 times higher than their sedentary counterparts. This elevated risk is primarily attributable to skin-to-skin contact during competitive events, poor hygiene practices, and the use of unclean sportswear. It is therefore imperative that athletes adhere to the highest standards of hygiene, including regular washing of equipment and maintaining impeccable personal hygiene, in order to minimize the risk of such infections. Notwithstanding the aforementioned risks, regular physical activity has also been demonstrated to enhance immune function, thereby strengthening the body's defenses against infections. Improved circulation, enhanced oxygenation, and more efficient immune responses facilitate the recuperation of athletes from minor skin irritations and infections.(26)

In addition to the potential for infection, physical activity has been demonstrated to exert an influence on inflammatory skin conditions. The results of studies on high-intensity resistance training (HIRT) indicate that exercise can reduce inflammation, even in chronic conditions such as atopic dermatitis (AD). By modulating the immune system and decreasing levels of

pro-inflammatory cytokines, exercise has been observed to alleviate symptoms such as skin thickness and redness, which are common in inflammatory skin diseases. This anti-inflammatory effect has been observed across various forms of exercise, including high-intensity interval training (HIIT), which has been demonstrated to significantly reduce systemic inflammation and may be an effective treatment for conditions such as acne and eczema.(27)

Another crucial element in the maintenance of optimal dermal health is the influence of exercise on oxidative stress. It is acknowledged that intense physical activity may initially result in an increase in oxidative stress due to the production of free radicals during the exercise itself. However, with regular training, the body adapts, thereby enhancing antioxidant defenses and mitigating the long-term effects of oxidative damage. This process helps to protect the skin from premature ageing, wrinkles and other oxidative stress-induced damage, such as the breakdown of collagen, which is vital for skin elasticity.(28)

In conclusion, while physical activity increases the risk of skin infections, particularly due to environmental factors and physical contact in sports, it also provides significant benefits in terms of reducing inflammation and oxidative stress. (29) Regular exercise has been demonstrated to assist in the prevention and management of skin infections, whilst also facilitating the regeneration of healthy skin tissue. This is achieved through the enhancement of circulation, the modulation of immune responses and the improvement of antioxidant defenses. It is of the utmost importance to strike a balance between the potential risks associated with exercise and the implementation of appropriate skincare and hygiene practices, in order to maintain optimal skin health and overall well-being.

How Friction During Exercise Affects Skin Health

During physical activity, friction from repetitive movements or contact with surfaces can damage the skin's outermost layer, the stratum corneum. (30) This wear weakens the skin barrier, making it more vulnerable to irritation, inflammation, and infection. Studies on friction-induced skin wear show that repeated friction significantly reduces skin thickness and impairs barrier function, with the degree of wear depending on factors like fabric type and skin contact.

Athletes, in particular, face a higher risk of skin issues due to friction, as it increases susceptibility to external pathogens. Understanding the impact of friction helps in developing protective measures, such as appropriate clothing and skincare products, to maintain skin integrity and prevent damage.(5)

Conclusion

This review highlights the intricate relationship between physical activity and dermal wellbeing, outlining the advantages and potential obstacles associated with it. Regular exercise has been demonstrated to enhance circulation, boost collagen production and lower cortisol levels. These effects contribute to improved hydration, elasticity and a youthful appearance. Such changes serve to support resilience of the skin and delay the ageing process by mitigating the effects of oxidative stress and inflammation. Both impact and non-impact exercises have been demonstrated to be effective in maintaining skin mechanics, promoting collagen turnover, and fostering dermal vitality.

The benefits of exercise extend beyond the musculoskeletal system to encompass the vascular system as well. Improved vascular function ensures more efficient delivery of nutrients and removal of toxins, which collectively contribute to healthier skin. However, it is of the utmost importance to address the potential risks associated with exercise, including damage to the skin barrier from friction, an increased susceptibility to infections, and adverse effects from prolonged sweating or UV exposure. It is of the utmost importance to adopt personalized skincare routines that focus on cleansing, moisturizing and sun protection in order to mitigate these challenges.

Moreover, exercise has been demonstrated to regulate cortisol levels, thereby reducing stress-related inflammation and improving skin barrier function and sebum production. This dual effect is beneficial for both mental well-being and skin condition.

In conclusion, it can therefore be stated that regular physical activity is essential for holistic skin health. By balancing the benefits with adequate skincare, individuals can optimize the positive effects of exercise on their skin. It would be beneficial for future research to explore the potential of combining exercise with dermatological care in order to support the development of healthy, resilient, and vibrant skin across a diverse range of populations.

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