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Fit body, fit skin – the multifaceted effects of physical activity on the skin

Sprawne ciało, sprawna skóra: wieloaspektowy wpływ aktywności fizycznej na skórę

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Abstract

Introduction and Objective. It is widely recognized that engaging in regular physical activity has a profound positive impact on overall bodily health. Skeletal muscles have been identified as an endocrine organ, exerting influence not only on nearby structures but also on distant organs and tissues through the release of myokines during exercise. Furthermore, studies indicate that physical activity exerts multifaceted effects on the skin. The aim of this study was to systematically review recent literature to examine the influence of physical activity on skin health.

Brief description of the state of knowledge. Existing studies consistently demonstrate that physical activity serves to decelerate the aging process of the skin, expedite wound healing, potentially exhibit anti-inflammatory effects, and consequently lower the risk of specific skin diseases. Conversely, reports suggest that exercise might contribute to the aggravation of certain skin conditions by elevating skin temperature and activating sweat glands. Additionally, engaging in physical activity is associated with a reduction in the accumulation of glycation end products in the skin of individuals with diabetes, effectively preventing late complications associated with the disease.

Summary. Currently, there are few studies focusing on the effects of physical activity on the skin. Thus, it is likely that all the skin benefits of exercise have not been explored. Nor are all the mechanisms klnown by which physical activity affects the skin. Further research exploring this topic is therefore needed. Additionally, efforts are required to increase public awareness about the health impacts of physical activity and promote regular engagement in physical exercise.

Key words

physical activity, exercise, skin

Streszczenie

Wprowadzenie i cel pracy. Powszechnie wiadomo, że regularna aktywność fizyczna ma pozytywny wpływ na ogólny stan zdrowia organizmu. Mięśnie szkieletowe pełnią funkcję narządu endokrynnego, wpływając nie tylko na pobliskie struktury, ale także na odległe narządy i tkanki za pomocą miokin uwalnianych podczas ćwiczeń. Co więcej, badania wskazują, że aktywność fizyczna wywiera wieloaspektowy wpływ na skórę. Celem tego artykułu było przeprowadzenie systematycznego przeglądu najnowszej literatury w celu zbadania wpływu aktywności fizycznej na zdrowie skóry.

Opis stanu wiedzy. Istniejące badania konsekwentnie wykazują, że aktywność fizyczna spowalnia procesy starzenia się skóry, przyspiesza gojenie się ran, potencjalnie wykazuje działanie przeciwzapalne, a w konsekwencji obniża ryzyko wystąpienia określonych chorób skóry. Istnieją jednak doniesienia sugerujące, że ćwiczenia mogą przyczyniać się do zaostrzenia niektórych chorób skóry poprzez podniesienie temperatury skóry i aktywację gruczołów potowych. Ponadto aktywność fizyczna przyczynia się do zmniejszenia akumulacji końcowych produktów glikacji w skórze osób z cukrzycą, skutecznie zapobiegając późniejszym powikłaniom związanym z chorobą.

Podsumowanie. Obecnie istnieje niewiele badań skupiających się na wpływie aktywności fizycznej na skórę. Jest więc prawdopodobne, że nie zostały zbadane wszystkie korzyści dla skóry wynikające z ćwiczeń. Nie znamy również wszystkich mechanizmów, za pomocą których aktywność fizyczna wpływa na skórę. Potrzebne są zatem dalsze badania w tym zakresie. Ponadto konieczne są działania mające na celu zwiększenie świadomości społecznej na temat wpływu aktywności fizycznej na zdrowie i promowanie regularnego angażowania się w ćwiczenia fizyczne.

Słowa kluczowe

aktywność fizyczna, ćwiczenia, skóra

INTRODUCTION

Physical activity offers numerous body benefits. Regular exercise has proven effective in preventing and treating conditions such as cardiovascular disease [1], coronary heart

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disease [2], type 2 diabetes [3], Alzheimer›s disease [4], among others. Additionally, physical activity positively impacts mental health [5].

In 2010, the World Health Organization (WHO) established the 'Global recommendations on physical activity for health' tailored for three age groups. The organization also launched the 'Global action plan on physical activity 2018–2030: more active people for a healthier world' to address insufficient physical activity worldwide [6]. These initiatives aim to enhance individual and societal well-being. This review investigates the added benefits of physical exercise on overall skin condition.

OBJECTIVE

The aim of the study was to conduct a comprehensive literature review focused on elucidating the impact of physical activity on skin health.

MATERIALS AND METHOD

The literature search was meticulously conducted using the PubMed and Google Scholar databases. Appropriate configurations of the keywords physical activity, exercise, and skin were employed in English. The search included scientific articles published within the last six years (2018–2023).

DESCRIPTION OF THE STATE OF KNOWLEDGE

Effect of physical activity on skin aging. A study conducted in 2020 in Japan evaluated the relationship between physical activity and the mechanical properties of the skin. The study lasted 70 days, during which physical activity was continuously monitored using a wristwatch-type device that measured heart rate and vertical acceleration. The intensity of physical activity was categorized into five grades. Subsequent to the 70-day period, the participants' skin was assessed for mechanical properties using a cutometer, which measured parameters such as the height of maximum skin strain, the ratio of viscoelastic to elastic strain, and the elasticity ratio. The findings indicated that a more extended duration of physical activity, with an intensity of at least 40% of the heart rate (calculated via Karvonen's formula: Intensity of physical activity = Pulse rate – resting pulse rate / (maximal pulse rate – resting pulse rate), was associated with a positive impact on maximal skin strain and a negative effect on the ratio of viscoelastic to elastic deformation. In contrast, there was no effect of physical activity on the elastic ratio [7]. In a separate investigation utilizing a cutometer, it was noted that the magnitude of maximum skin deformation decreased with age, accompanied by an increase in the ratio of viscoelastic to elastic deformation [8].

From these findings, it can be deduced that physical activity exceeding a warm-up intensity contributes to enhancing the mechanical properties of the skin, countering the natural deterioration associated with aging. This improvement might be attributed to the impact of physical activity on skin collagen content, as suggested by animal studies. Notably, a study conducted by Yuri Ishiuchi-Sato and Taku Nedachi demonstrated that the reduction in CXCL10 myokine, induced by skeletal muscle contraction during exercise, stimulates collagen production in mouse fibroblasts [9]. Another study revealed that interleukin-15 (Il-15), a myokine whose secretion from skeletal muscle increases with exercise, can inhibit collagen loss and enhance mitochondrial activity in the dermis of aging mice [10].

Consistent conclusions were drawn by researchers Crane, MacNeil et al., who showed that endurance exercise mitigates age-related skin changes in both mice and humans. This effect may be attributed to exercise influencing Il-15 expression via skeletal muscle-activated protein kinase AMP. Significantly, the elimination of muscle AMPK has been linked to the deterioration of skin structure, while daily Il-15 treatment has demonstrated similar anti-aging effects on both muscle and skin in mice, comparable to the effects of exercise [11].

Studies have revealed that skeletal muscles, through the secretion of myokines during exercise, wield influence over the skin and various tissues and organs within the body, functioning somewhat like endocrine organs [12, 13]. Furthermore, it has been established that aerobic and resistance training exert disparate effects on the body, leading to varying impacts on the release of numerous factors into circulation [14, 15, 16].

A similar issue with regard to skin was addressed by researchers Shu Nishikori, Jun Yasuda et al. who compared the effects of aerobic and resistance training on skin aging. The randomized study, which lasted 16 weeks, involved 61 healthy middle-aged women with sedentary lifestyles. Levels of more than 1,480 different factors in the bloodstream before and after training were measured, and the expression of genes related to the extracellular matrix of the skin's ECM was assessed in the subjects [17]. Notably, prior research had underscored the influence of the skin's extracellular matrix (ECM) on two crucial aspects of skin aging: elasticity [18] and the dermal structure, evaluated through ultrasound echogenicity [19].

In the aerobic training group, there was an increase in the circulating levels of various factors, including myokines such as IL-15 and myonectin, while levels of inflammatory factors such as tumour necrosis-related apoptosis-inducing ligand and interferon gamma decreased. Conversely, the resistance training group exhibited heightened levels of myokines, such as cathepsin B, C-X-C motif chemokine ligand 8 (CXCL8), and regulated on activation, the normal T-cell expressed, among others. Inflammatory factors, including monocyte chemotactic protein 3 and C-C motif chemokine ligand 28 (CCL28), decreased in this group.

Distinguishing effects were observed between aerobic and resistance training on the expression of genes associated with the skin's extracellular matrix (ECM). Following aerobic training, there was an up-regulation in the expression of collagen genes, including COL1A2, COL12A1, and COL5A1. Conversely, resistance training led to increased expression of proteoglycan-related genes, specifically biglycan (BGN) and chondroitin sulfate synthase 1 (CHSY1).

Both resistance and aerobic training groups exhibited heightened skin elasticity and improvements in the upper dermal structure, as indicated by the increased count of low-echogenic pixels (LEP). Furthermore, the resistance training group experienced increased skin thickness, coupled with a reduction in CCL28, N,N-dimethylglycine, and CXCL4 levels. This correlated with an elevation in BGN gene expression [17]. Given that the thinning of the skin is a known symptom of aging, resistance training emerges as having a more advantageous rejuvenating effect on the skin,

impacting three facets of the aging process.

The issue of the effect of facial muscle exercise on signs of aging was addressed by Alam, Walter et al. Their 20-week study showed that a 30-minute daily or alternative facial muscle exercise programme could improve the facial appearance of middle-aged people (aged 40–65 years), as assessed by standardized photographs based on the Merz-Carruthers Facial Aging Photoscales (MCFAP). Facial exercise resulted in an improvement in mean (SD) upper cheek fullness (1.1 [0.6] vs. 1.8 [0.7]; P = 0.003) and lower cheek fullness (0.9 [0.7] vs. 1.6 [0.9]; P = 0.003) after 20 weeks compared to baseline (based on MCFAP scales). The baseline value of mean (SD) estimated age also decreased, at the end of the study (50.8 [4.8] y vs 48.1 [5.5] y; P = 0.002). It has also been observed that exercising facial muscles contributes to the smoothing of some wrinkles: e.g., marionette lines, lips wrinkles at rest [20].

The impact of facial muscle exercise on aging signs was investigated by researchers Alam, Walter et al. In their 20-week study, a daily or alternate 30-minute facial muscle exercise program showed notable improvements in the facial appearance of middle-aged individuals (40–65 years old). The evaluation was based on standardized photographs using the Merz-Carruthers Facial Aging Photoscales (MCFAP). Facial exercise led to enhancements in mean (SD) upper cheek fullness (1.1 [0.6] vs. 1.8 [0.7]; P = 0.003) and lower cheek fullness (0.9 [0.7] vs. 1.6 [0.9]; P = 0.003) after 20 weeks compared to baseline, as per the MCFAP scales. Moreover, the baseline mean (SD) estimated age decreased by the end of the study (50.8 [4.8] y vs. 48.1 [5.5] y; P = 0.002). Additionally, exercising facial muscles was observed to contribute to the smoothing of specific wrinkles, such as marionette lines and resting lip wrinkles [20].

The potential mechanism underlying these effects may involve exercise-induced hypertrophy of the cheeks and other muscles. However, it is crucial to note that the role of myokines released during exercise, which was not explored in this study, should also be considered.

Effects of physical activity on wound healing. Emerging evidence suggests that physical exercise may have a positive effect on skin wound healing. Notably, studies conducted on mice have demonstrated that endurance training and treadmill running significantly expedited the wound healing process, irrespective of age [10, 21].

Furthermore, an investigation assessing the effects of both obesity and exercise on mouse skin yielded parallel findings. Obesity was found to be associated with impaired wound healing, reduced collagen levels, and skin thinning. Encouragingly, these detrimental changes were reversible through the influence of regular physical activity [22].

Impact of physical activity on skin diseases. A study conducted in Germany among élite athletes revealed that compared to recreational athletes, competitive athletes had a lower likelihood of experiencing inflammatory, seborrheic, and infectious skin diseases. Specifically, conditions such as neurodermatitis, acne, herpes, tinea pedis (athlete's foot), pruritus, and bullae (blisters) were observed less frequently [23]. Another study highlighted the positive impact of physical activity in reducing symptoms of psoriasis [24]. The probable explanation for these observations lies in the beneficial effects of physical activity on the immune system and its anti-inflammatory properties [25, 26].

Conversely, a 2017 study conducted in Spain revealed that individuals, particularly men, with chronic skin conditions such as psoriasis, acne, eczema, and vitiligo tend to be less physically active. This decline in physical activity is likely associated with a fear of worsening their skin conditions [27].

Evidence suggests that physical activity may contribute to the exacerbation of skin diseases by increasing the temperature of the skin and activating the sweat glands [28]. Moreover, athletes are shown to be at a higher risk for specific dermatological conditions, attributed to factors such as increased sweating, exposure to extreme temperatures, close body contact, and intensive training [29]. However, a comprehensive study conducted in 2014 by Kruk et al. shed light on this apparent contradiction. Their findings indicate that regular moderate physical activity can act as a protective factor against oxidative stress on the skin. Interestingly, they observed that endurance exercise without proper training could induce oxidative stress in the skin [30].

Positive effects of physical activity in diabetic patients. Glycation end products (AGEs) are implicated in chronic hyperglycaemia, metabolic disorders, and age-related diseases. Endogenous AGEs, produced within the human body, induce oxidative stress and activate inflammatory signaling pathways through AGE-specific receptors [31].

Remarkably, physical activity appears to exert a positive influence on the skin and other tissues, extending its benefits even to individuals with type 1 diabetes. It induces a reduction in the skin's accumulation of endogenous glycation products (AGEs), which play a pivotal role in the onset of late complications associated with diabetes [32].

In the realm of type 2 diabetes, increasing levels of physical activity and intensifying exercise regimens yield significant improvements. These positive changes include enhanced microcirculation and more robust dilation of skin vessels, particularly pronounced in type 2 diabetics compared to their healthy counterparts [33].

SUMMARY

This review shows that physical activity has numerous benefits for the skin: it slows down the aging process of the skin and has a rejuvenating effect, accelerates wound healing, may have anti-inflammatory effects and thus reduce the risk of certain skin diseases. On the other hand, there are reports that exercise may contribute to the exacerbation of some skin diseases, by increasing skin temperature and activating sweat glands. In addition, physical activity decreases the accumulation of glycation end products in the skin of diabetics, which prevents late complications of diabetes.

However, so far there are only a few studies focusing on the effects of physical activity on the skin. It is therefore likely that all benefits of exercise on the skin have not yet been explored. All the mechanisms by which physical activity affects the skin are also unknown. Further research exploring this topic is therefore needed.

There is also an urgent need for efforts to raise people's awareness of the effects of physical activity on health and proper functioning of the body, and to mobilise people to be active on a regular basis.

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