

LESZYŃSKA, Agnieszka, BAŁONIAK, Julia, BAŁONIAK, Zuzanna, JONKISZ, Aleksandra, DOLIGALSKA, Michalina, STREMEL, Aleksandra, BACHOŃ, Emilia, SKURZYŃSKA, Gabriela and KOZŁOWSKA, Dominika. Physical activity in atopic dermatitis: a narrative review. *Quality in Sport*. 2024;36:56581. eISSN 2450-3118.

<https://doi.org/10.12775/QS.2024.36.56581>

<https://apcz.umk.pl/QS/article/view/56581>

The journal has been 20 points in the Ministry of Higher Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Higher Education and Science of 05.01.2024. No. 32553.

Has a Journal's Unique Identifier: 201398. Scientific disciplines assigned: Economics and finance (Field of social sciences); Management and Quality Sciences (Field of social sciences).

Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 r. Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398.

Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

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The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 02.12.2024. Revised: 24.12.2024. Accepted: 24.12.2024. Published: 24.12.2024.

PHYSICAL ACTIVITY IN ATOPIC DERMATITIS: A NARRATIVE REVIEW

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Abstract

Atopic dermatitis (AD) is a common chronic skin disease that impacts various aspects of a patient's life. Among numerous triggers, there is a specific group of factors that may arise during physical activity. Due to skin-related issues, which can be both a significant obstacle and a source of fear regarding symptom exacerbation, the habits and behaviors of patients

with AD differ from those of the general population. Understanding these changes can provide valuable insights into which types of sports or physical activities should be recommended by physicians, physiotherapists, or other professionals involved in sports and health.

In this review, we analyze studies conducted on this topic and aim to draw conclusions on how to best promote physical activity in patients with AD while minimizing its negative impact on their skin. We emphasize the lack of essential studies that involve engaging patients with AD in various forms of physical activity and subsequently assessing their skin condition and symptom severity after exercise.

Keywords: physical activity, sport, atopic dermatitis, dermatology

Introduction

Atopic dermatitis (AD) is a common chronic skin disease that affects approximately 3% of the adult population and 20% of children, with its prevalence still increasing. (1) AD is characterized by dry skin, pruritus, lichenification, and frequent eczematous abrasions, with onset early in life. It often precedes other allergic diseases, such as asthma or allergic rhinitis, making AD the first stage in the "atopic march." The pathophysiology of AD is dynamic and multifactorial, involving aspects of skin barrier failure, shifts in cell-mediated immune responses, IgE-induced hypersensitivity, and environmental influences. It also arises due to a complex interplay between genetic predisposition, the host's environment, pharmacological abnormalities, and immunological factors. (2) Regular physical activity is recognized as one of the most significant factors influencing both the length and quality of life. There is irrefutable evidence of the effectiveness of regular physical activity in the primary and secondary prevention of several chronic diseases, such as cardiovascular disease, diabetes, cancer, hypertension, obesity, depression, and osteoporosis, as well as in reducing the risk of premature death. (3) This is especially important for adults with AD, as the condition is associated with a significantly higher risk of cardiovascular disease. (4)

The aim of this review is to analyze the influence of sports and physical activity on individuals with AD, considering not only their skin condition but also their behaviors and habits related to sports participation. Additionally, this review aims to assist physicians in recommending appropriate physical activities, particularly for individuals who may benefit from weight loss. Furthermore, this information is valuable for personal trainers, physical education teachers, and physiotherapists to help them adapt exercise routines for individuals with AD and provide advice to reduce unpleasant symptoms, such as itching, that may occur during physical activity.

1. Pathophysiology of Atopic Dermatitis

AD is a disorder with a complex pathophysiology, but its general features are barrier dysfunction and skin inflammation. Loss of barrier function may be considered a genetic disorder and is linked to mutations in the filaggrin (FLG) gene, which encodes the essential barrier protein (pro-)filaggrin.(5) Filaggrin aggregates keratin filaments into compact bundles and influences keratinocyte composition and the granular cell layer. Reduced filaggrin metabolites, such as natural moisturizing factor, alter skin hydration and pH. Elevated skin pH activates serine proteases and kallikreins, leading to the degradation of corneodesmosomes and a reduction in ceramide synthesis, which is responsible for increased transepidermal water loss (TEWL) and decreased skin hydration. These changes lead to increased Th2 inflammation and greater allergen penetration through the skin. (6, 7) The cytokine milieu in the skin reduces filaggrin expression via Th2 cytokines, IL-17, IL-22, IL-25, or IL-31. High levels of Th2 cytokines in AD skin increase serine protease kallikrein 7 (KLK7), and elevated levels of serine proteases lead to skin barrier dysfunction. Importantly, in patients with AD, the cytokine network promotes excessive IgE production and contributes to the development and maintenance of allergic inflammation. (8) Additionally, activation of TLR2 on monocytes in patients with AD leads to different cytokine and chemokine responses compared to healthy individuals. Concerning TLR4, in an allergen-induced mouse model, mice deficient in TLR4 exhibit more severe AD-like symptoms and skin inflammation. (9, 10) Inflammatory AD skin contains large numbers of resident and infiltrating immune cells. Among these, dendritic cells (DCs) play a central role in initiating Th2 immune responses. Th2-type cytokines, including IL-5, IL-9, and IL-13, further promote local inflammation.

Another critical issue is the microbiome on the skin surface. The interaction of microbes with the skin immune system plays a significant role in the pathogenesis of AD. Due to various factors, such as higher pH and a Th2-dominated micromilieu, elevated amounts of *Staphylococcus aureus* (*S. aureus*) are detectable on AD skin. This theory is supported by the observation that, after treatment and improvement of skin lesions, *Propionibacteriae*, *Corynebacteriae*, and *Streptococci* are found in increased amounts on AD skin. (11) Genetic predisposition to AD can be influenced by various environmental factors, which may also exacerbate the condition. These include, among others, irritants, pruritogens, climate, allergens, and microbiome dysbiosis.(12)

2. Risk Factors During Physical Activity

There are several environmental risk factors for AD that may arise during physical activity, but there are also protective factors, which are explored in this study.

During physical activity, body heat increases, which can lead to sweating and vasodilation in the skin layers, resulting in redness. The intensity of these reactions depends on various factors, such as the ambient temperature, the type of exercise performed, humidity levels, and other environmental conditions.

In a questionnaire-based study by Williams et al., sweating from exercise, fabrics, and hot weather were identified as the three most common exacerbators reported by 12-14-year-old children with AD. (13) In a questionnaire study conducted in Singapore, the most aggravating factors reported were exercise, heat and sweating, grass intolerance, thick clothing, and stress. (14) The sensation of heat during exercise is a conflicting factor. On one hand, multiple studies have shown that hot water increases itching and other AD symptoms. On the other hand, studies have also indicated that in regions with warmer climates and higher temperatures, the prevalence of AD is less common.

In another questionnaire-based study, where stress, dampness, and heat were considered as flare factors, multivariate analysis of all significant variables showed that only dampness was significantly associated with AD flares. (15) However, a study conducted in Spain involving 28,394 schoolchildren found a negative association between outdoor temperatures and AD prevalence, while precipitation and humidity were positively associated with AD. (16)

A large Brazilian study conducted across the entire country showed that in the north of Brazil, where temperatures and humidity are higher, the prevalence of AD is greater than in the south, where the climate is drier and cooler. (17) The results of studies investigating the impact of temperature on AD are inconsistent. To fully understand this issue, we need to consider other aspects of the climate beyond heat and humidity, such as sunlight exposure, and additional factors that influence the overall climate, including air circulation and seasonal variations.

The influence of sun exposure as a factor in AD is particularly interesting, as UV radiation has been documented as an effective treatment. Petrizi et al. conducted a study on the effect of sun exposure during holidays on skin with atopic eczema, showing that 74.4% of patients with mild-to-moderate AD experienced complete resolution during summer holidays, 16.3% showed improvement, and only 9.3% reported no change in disease severity. The study also found that seaside holidays resulted in greater improvement than mountain holidays, with complete resolution in 91.2% versus 11.1% of patients, respectively. (18)

The study supports the hypothesis of the positive effect of UV radiation on atopic dermatitis. Similar results were observed in a retrospective study involving 114 patients. In this study, sunlight was considered beneficial by 33.3% of participants who reported improvement in AD and 26.3% who experienced complete resolution of the disease during summer holidays. (19)

The impact of sun exposure was also examined in the context of climate change. A study conducted with Norwegian children with severe atopic eczema randomized participants to stay in Gran Canaria or at home. The change from a subarctic/temperate climate to a subtropical climate for four weeks significantly improved skin symptoms and quality of life, with the effects lasting for up to three months after their return. (20) Similar studies have also been conducted, each showing comparable results that indicated improvement in AD disease activity and the quality of life of atopic patients. (21)

As we can see, these studies, although primarily examining the effects of increased sun exposure on the skin, also consider other variables that influence the overall climate. However, the study by Gambichler et al. specifically analyzed the effects of ultraviolet A1 (UVA1) phototherapy in a controlled environment, using lamps that emitted specific wavelengths of light without altering the patients' external conditions. A significant reduction was observed, accompanied by decreased mRNA expression of IL-5, IL-13, and IL-31, cytokines that play a crucial role in the pathogenesis of extrinsic AD. (22) AD patients experience sweat-related dysfunctions, including altered sweat composition, sweat allergy, and abnormal sweat patterns and responses. It is also well-documented that AD patients sweat less compared to healthy individuals. (23)

The connection between AD symptoms and sweating is well-researched in the literature. Although sweating is one of the most common triggers for symptom exacerbation, the study by Nattkemper et al. demonstrated that experimentally induced sweat attenuated cowhage-induced itch in both healthy individuals and those with AD. (24) These findings suggest that patients with AD may benefit from physical activities that induce sweating, provided that they rinse sweat off afterward to avoid leaving excessive sweat on the skin surface.

This is confirmed by a study conducted in an elementary school, where children with AD participated in "shower therapy" during the school lunch break for six weeks in the summer. Remarkably, all 53 participants demonstrated an improvement in their AD symptoms. (25) Similarly, Kaneko et al. experimentally induced sweating in participants with AD and instructed them to rinse off sweat afterward. Their results showed that 25% of patients reported a favorable impact on their symptoms when following these instructions. However, 75% of participants noted that while "rinsing sweat off" was beneficial, "incorporating activities with sweating" worsened itching and dermatitis. (26)

An important consideration is also the clothing worn during physical activity. Cotton and silk have traditionally been recommended for patients with AD, but these materials are not commonly used in sportswear. Despite large-diameter wool being known to induce itching and irritation, merino wool is non-pruritic and may be recommended as an alternative.(27) This is particularly beneficial for athletes, as thermal underwear is often made from merino wool. Emerging fabrics that show potential for reducing AD severity include silver-coated, chitosan-coated, and cellulose-based fabrics. While fabrics such as zinc oxide-coated, acid-coated, polyurethane-coated, borage seed oil-coated, anionic, lyocell, and ethylene vinyl are less commonly used and have limited evidence. Among these, lyocell and certain polyurethane-coated materials are gaining popularity in sports fashion for their moisture-wicking and comfort properties. (28, 29) It's not only the fabric that matters but also the design of sportswear. Evidence suggests that tight-fitting clothing can exacerbate itching in patients with AD, highlighting the importance of loose-fitting, breathable garments during physical activity. (30, 14)

3. Impact of Sports Engagement on Atopic Dermatitis

Despite the issues and risk factors associated with physical activity in patients with AD, its overall impact remains positive. A Swedish questionnaire-based study involving 1,065

participants investigated whether patients with AD engage in reduced levels of physical activity due to their condition. The study explored differences between groups by examining exercise habits, motives for exercise, experiences during childhood and adolescence, and satisfaction with physical performance.

The results showed that there were no differences between the groups in terms of overall physical activity levels. However, there was a difference in the type of activity: the patient group avoided swimming and preferred exercising outdoors, where they were less likely to become excessively sweaty. (31) In the Taiwan study examining participation in sports, no significant difference was observed between the two groups in regular engagement in outdoor and indoor exercise. However, the AD group had a lower weekly exercise volume compared to the control group. (32) On the other hand, an American study on children showed that severe eczema was associated with decreased odds of engaging in at least one day of vigorous physical activity and reduced odds of sports participation in the past year. (33)

A study by Chatelain et al. confirms that AD influences physical activity in patients and is an aggravating factor for eczema in 61% of cases. However, sports were also seen as a form of relaxation by 54% of patients with AD. Only 6% of participants reported that sports were a source of stress. Interestingly, although 70% of participants reported that eczema hindered their ability to practice sports, only a few completely abandoned physical activity, while most modified their approach to exercise. (34) Most of the studies cited here rely on questionnaires filled out by AD patients, which may not reliably predict actual activity levels. However, in a study by Silverberg, patients were invited to wear a waist-mounted accelerometer to objectively measure ambulatory physical activity. The results showed that adult AD was associated with significantly lower average total counts of daily activity and moderate-to-vigorous physical activity. However, no association was found with sedentary time or light physical activity. (35)

Unfortunately, none of these studies examined how exercise impacts the skin or symptoms in patients with AD; they focused solely on behaviors and sports habits within this group. There is a significant lack of studies in which researchers specifically investigate the type of sport and its effects on general health, skin condition, and mental health in patients with AD. While there is a considerable amount of research on the general habits and behaviors of people with AD, no studies have measured the impact of a specific sport on the manifestation or progression of the disease. Thus, to gain a deeper understanding of this issue, we are forced

to draw conclusions from other studies that examine the impact of sports on skin health in general, rather than focusing specifically on populations with AD, such as studies investigating skin conditions in athletes.

Due to the fact that swimming is a physical activity involving many factors that impact skin condition, and because it includes several elements considered to exacerbate AD, numerous studies have analyzed the effects of this type of exercise in individuals with AD.

The study conducted with elite swimmers showed that transepidermal water loss (TEWL) was increased compared to football players, both before and after training, which may suggest that exposure to a swimming pool environment can lead to changes in skin barrier function. (36) This study was conducted on a healthy population (without AD), but nevertheless, it shows a significant impact. In patients with AD, TEWL is generally higher than in healthy individuals due to skin barrier dysfunction, so the differences may be even greater, and swimming could potentially have a more pronounced effect on the skin compared to healthy individuals. In another study, where TEWL was measured in people with varying activity levels (not just swimmers), no significant differences were found in TEWL. (37)

The review article explored the connection between swimming and AD, highlighting potential interventions to reduce damage, such as emollient application, special swim gear, and showering after submersion. The benefits of swimming as a form of exercise for individuals with AD include reduced sweating, improved cardiorespiratory fitness, and maintenance of a healthy weight. (38)

Discussion and conclusion

Physical activity is an essential part of a healthy lifestyle, but the impact of AD cannot be overlooked. Numerous studies indicate that individuals with AD often have a different approach to sports and exhibit distinct behaviors related to physical activity. This is largely due to factors such as heat, sweat, and exercise, which are commonly reported exacerbating factors for AD. Patients with eczematous lesions on the hands and feet may face limitations in physical activities, while comorbidities like fatigue, sleep disturbances, and depression can also contribute to decreased physical activity in AD. Interestingly, patients with AD tend to modify the type, duration, or other aspects of their physical activity due to the disease, which

can help us identify the most suitable exercises for them and create personalized recommendations.

The environment and choice of activity setting are crucial factors. People with AD should prepare for physical activity by taking care of their skin, such as applying emollients before exercise, and by choosing outfits made from lyocell and certain polyurethane-coated materials that don't cling to the body. Furthermore, evidence clearly shows that sweating is one of the common risk factors that exacerbate AD. Therefore, patients should avoid high-sweat activities like running and opt for exercises with moderate intensity, such as pilates, yoga or long walking, which are less likely to trigger excessive sweating. Studies also emphasize the importance of showering after physical activity to remove sweat. Simple post-exercise routines, such as a warm bath, applying emollients, and taking a short rest, have been shown to help prevent itching induced by sweating. (39, 40)

The location of physical activity is debatable. On one hand, outdoor activities may offer benefits due to sun exposure, as studies suggest that people living in warmer climates, who spend more time outdoors and have greater UV exposure, may experience a protective effect against AD. (41) However, studies have shown that outdoor air pollution can exacerbate the symptoms of atopic dermatitis, and allergens present outdoors may further worsen the condition. (42, 43) On the other hand, indoor activity in spaces with air conditioning may reduce sweating and be beneficial.

It's essential to remember that the sun is a major risk factor for melanoma, and recommendations suggest using UV protection, such as sunscreen, long-sleeve clothing, or hats. Additionally, we must be aware that patients may have not only AD but also other comorbid conditions, which should be considered when making recommendations.

We also need to emphasize the positive influence of sports and physical activity on mental well-being. AD significantly impacts patients' quality of life, with many experiencing suicidal thoughts and emotional distress. (44) Regular physical activity has been shown to improve mood, enhance overall well-being, and increase life satisfaction (31, 34).

Considering the aforementioned principles, there are no strictly prohibited physical activities for individuals with AD. However, activities that result in less sweating are generally better for the skin. It's also important to remember general guidelines, such as the use of emollients and proper hygiene after exercise.

Author's contribution

Author Agnieszka Leszyńska contributed significantly to the development of the concept and performed the analysis for this article, while the remaining authors contributed to the writing and revision of the manuscript.

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All authors have read and agreed with the published version of the manuscript.

Funding Statement

The authors report no sources of support, grants, equipment, or drugs presented in this article.

Acknowledgments

None.

Conflict of Interest Statement

The authors report no competing interests.

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