ŁAZICKA, Patrycja, JAKUBOWSKA, Eliza and TARNOWSKA, Julia. Approaches to the diagnosis of Cutaneous Diseases Among Swimmers: Causes, Symptoms, Prevention, Treatment. Quality in Sport. 2025;37:56586. eISSN 2450-3118.
https://doi.org/10.12775/QS.2025.37.56586
https://apcz.umk.pl/QS/article/view/56586

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).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 02.12.2024. Revised: 03.01.2025. Accepted: 03.01.2025 Published: 03.01.2025.

Approaches to the diagnosis of Cutaneous Diseases Among Swimmers: Causes, Symptoms, Prevention, Treatment

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ABSTRACT

Introduction

The environment in which the sports enthusiast participates may influence the dermatoses that develop. Skin dermatoses are a significant health problem among athletes, especially swimmers, exposed to long-term contact with water and chemicals used in swimming pools. The use of appropriate diagnostic and preventive strategies, such as functional sports clothing, prevention before the occurrence or rapid diagnosis, can significantly reduce the risk of these diseases.

Aim

The aim of this article is to discuss the main approaches to the diagnosis of dermatoses in swimmers, their prevention and treatment.

Materials and methods

The review was based on the analysis of materials collected in the Google Scholar and,, PubMed''. The following keywords were entered during the search for scholarly articles: dermatoses, swimmers, skin infections, xerosis, sport. A total of 48 articles were considered for the study and verified for their relevance to the topic.

State of knowledge

Dermatoses in swimmers are the result of a combination of several factors, including impaired skin barrier, bacterial, viral and fungal infections, contact dermatitis, sun-related conditions or acne mechanica. Chemical agents such as chlorine used to disinfect swimming pool water may irritate the skin, causing contact dermatitis. Moreover, mechanical factors, such as skin friction against swimming equipment, and a humid environment leads to fungal and bacterial infections, combined with contact with allergens, e.g. latex, may lead to irritation, hives or other allergic reactions.

Summary (Conclusions)

Swimmers require a comprehensive approach that combines precise diagnostics with effective preventive measures. Proper skin care is crucial, including the use of emollients, protective creams and quick removal of chlorine residues from the body surface after training.

Keywords: dermatoses; swimmers; skin infections; xerosis; sport

Introduction

Exposure to moisture, heat, cold, wind, chemicals, and sunlight (especially in open pools) contributes significantly to the incidence of skin conditions in swimmers [1]. The environment in which the sports enthusiast participates may influence the dermatoses that develop. Aquatic sports occur in either freshwater or saltwater. Participants of aquatic sports in the freshwater environment may develop activity related skin conditions [2,3]. The skin is a large organ composed of three main layers: hypodermis, dermis, and epidermis. The primary

role of the hypodermis is protection against mechanical injury, and thermal insulation. In addition, it provides support and energy for the body - fat cells store triacylglycerols (TAGs), which are produced during lipogenesis [4]. Moreover, skin is the human body's largest organ, covering a surface area of about 2 sqm in an average adult [5]. The outermost layer of the skin, being the actual physical barrier between the body and the environment, is the epidermis. Among the most important components of human skin are lipids. These hydrophobic molecules are important for the proper functioning of the protective barrier. They prevent the entry of microorganisms and inhibit transepidermal water loss (TEWL) [6]. Skin participates in thermal regulation by conserving or releasing heat and helps maintain the body's water and homeostatic balance. Additionally, skin allows smooth movement of the body and protects against microorganisms, dehydration, ultraviolet light, and mechanical damage; the skin is the first physical barrier that the human body has against the external environment [7,8,9]. Physical activity and sports have become part of current life, even among amateur athletes. The benefits of sports are unquestionable, although participating in sports can be associated with several skin problems. Mechanical trauma, exposure to environmental and infectious agents, as well as contact with various other factors and with the skin of other athletes increase the chances of getting an infection. Furthermore, physical effort often exacerbates existing dermatological lesions. These conditions can be categorized into several sections, such as inflammatory diseases, infectious diseases, or those caused by mechanical factors [10,11,12,13]. Many factors can adversely affect the skin, compromising its function as an integral barrier of the body. Consequently, this may lead to the development of dermatoses, which are particularly common among athletes due to frequent exposure to sweat, clothing, sports equipment, and the environments in which they train [14]. The aim of the article is to present the diagnosis, prevention and treatment of skin diseases occurring in swimmers.

Materials and Methods

The review was based on the analysis of materials collected in the Google Scholar and,, PubMed''. The following keywords were entered during the search for scholarly articles: dermatoses, swimmers, skin infections, xerosis, sport. A total of 48 articles were considered for the study and verified for their relevance to the topic.

State of Knowledge

Causes and mechanisms of dermatoses among swimmers

Dermatoses in swimmers are the result of a combination of several factors, including impaired skin barrier, bacterial, viral and fungal infections, contact dermatitis, sun-related conditions or

acne mechanica. Chemical agents such as chlorine used to disinfect swimming pool water may irritate the skin, causing contact dermatitis. Moreover, mechanical factors, such as skin friction against swimming equipment, and a humid environment leads to fungal and bacterial infections, combined with contact with allergens, e.g. latex, may lead to irritation, hives or other allergic reactions. An athlete's skin is particularly susceptible to a wide array of repetitive physical and environmental conditions that challenge the skin's protective function. Athletic skin problems are widely transmissible in nature due to the inherent environment of close-contact physical activity. Other skin conditions can manifest or worsen with recurring mechanical or traumatic injury or exposure to environmental hazards. Additionally, sports-related activities may exacerbate further established dermatological conditions that may possibly be unknown to the athlete or clinician. [15,16].

Impaired skin barrier

Xerosis is a common problem with significant sequelae in competitive swimmers, and it results from transepidermal water loss. This study evaluates moisture barriers for reducing xerosis in competitive swimmers. Artificial skin preservation varied for five commercially available moisture barriers. Moisture barrier application improved moisture content and reduced xerosis in competitive swimmers [17]. Taking long showers with scrubs and soaps after activity cause sebum dilution with water, osmotic effect, and stripping off the stratum corneum [2].

Swimmer's itch

Cercarial dermatitis is a waterborne non-communicable skin condition caused by schistosome cercariae released by aquatic snails. The itchy maculopapular rash develops on exposed areas of the skin and typically resolves within 1–3 weeks. Shedding of infective larvae from snails is temperature dependent, and high temperatures and sunshine increase the risk of encountering the parasite and becoming infected [18].

Bacterial infections

Pseudomonas hot hand-foot syndrome is a distinct syndrome that usually occurs in children after having been exposed to water in a swimming pool. The bacteria cause symptoms localized to the mechanically stressed areas of the plantar foot. The affected individual presents with exquisitely painful erythematous nodules on the plantar feet; walking may also be painful. Symptoms and lesions of Pseudomonas hot-foot syndrome occur within hours to

days after exposure to bacteria-containing water. Similar to Pseudomonas hot-foot syndrome, Pseudomonas folliculitis results from aquatic exposure to Pseudomonas aeruginosa-contaminated water. Pseudomonas folliculitis lesions present as follicular-based pustules; hence the plantar feet are never affected, and rarely lesions may occur on the dorsal feet in individuals who have hair-bearing skin in that area [19]. Mycobacterium abscesses is an environmentally atypical mycobacterium hand-and-foot disease is an uncommonly reported mycobacterial infection of wading pool or swimming pool participants. The clinical manifestations of the infection present as multiple, red to purple, lesions. The morphology of the lesion includes macules, firm papules and nodules, and pustules. The lesions are either painless or tender, painful nodules, papules, macules, and pustules on the palms and soles [20].

Viral infections

skin viruses that are generally prevalent in the wider population—often driven by external factors could disrupt training programs for swimmers and lead to more serious health concerns. Warts are benign proliferative lesions of the skin and mucous membranes caused by the human papillomavirus (HPV). There are 231 types of HPV. Skin infection known as molluscum contagiosum is caused by the molluscum contagiosum virus, belonging to the Poxviridae family. Swimmers are particularly prone to this disease, because of development and the use of swimming pools and saunas. Additionally, infection can occur through direct contact, especially among individuals [2]. Viral warts are caused by an infection with the human papillomavirus (HPV), which is transmitted through direct skin contact or the sharing of hygiene items. Black spots become visible beneath the hyperkeratotic layer, caused by micro thrombosis in the capillaries. Plantar warts caused by HPV-1 are the most common infection among swimmers. Damage to the epidermis from prolonged exposure to a humid environment facilitates the spread of the infection. The lesions typically appear as endophytic lumps on the soles and lateral surfaces of the toes. [21-25]. Other common viral skin infections are those caused by the herpes simplex virus (HSV). This virus has a global distribution, affecting all populations and impacting both individual and public health. Once infection occurs, it remains lifelong with intermittent clinical and subclinical reactivation [26].

Fungal infections

Toe web infection can be caused by a dermatophyte superficial fungal organism such as Epidermophyton floccosum, Trichophyton mentagrophytes, or Trichophyton rubrum. In this

situation, the toe web infection has also been referred to as foot intertrigo or toe web intertrigo. Some affected individuals have a mixed infection of bacteria and fungi [2,27]. People with comorbidities such as diabetes, obesity, atherosclerosis, and weakened immunity are at an increased risk of complications, including ulcers and exudate formation. Desquamative (hyperkeratotic) tinea pedis affects the soles and lateral surfaces of the feet and is often associated with onychomycosis. Tinea inguinalis is an infection caused by dermatophytes, primarily Epidermophyton floccosum or Trichophyton rubrum (particularly in patients with athlete's foot). The highest risk of infection occurs in crowded environments and among individuals participating in contact or team sports. Excessive sweating, tight underwear, and poor hygiene are key predisposing factors. The initial symptoms include slowly spreading erythematous lesions, often accompanied by itching and burning. These lesions typically affect the skin of the groin but may also extend to the scrotum, thighs, and buttocks [28,29]. Tinea pedis should be differentiated from pitted keratolysis, caused by Corynebacteria, which presents with the small punched-out depressions and an unpleasant smell. Tinea can be prevented by proper foot hygiene and patient education. Initial treatment involves topical antifungals twice daily for one to two months, but systemic antifungal agents may be used if refractory disease is present [15].

Contact dermatitis

Increased allergy rates may be partly explained by the use of chlorinated or brominated disinfectants in swimming pools that may increase sensitization to other allergens [30]. Contact dermatitis is any inflammatory reaction of the skin that results from direct contact with an offending agent. Recognizing the unique environmental irritants and allergens encountered by athletes is paramount to facilitate appropriate therapy and prevention. Typically affects individuals previously sensitized to the substance and represents a delayed-type hypersensitivity reaction, which demonstrates a lag-interval of several hours to days from the initiation of the immunological cascade and the manifestation of symptoms [16]. Allergic contact dermatitis can also be caused by certain clothing and equipment swimmers use. Early reports described reactions to the components of resins (thioureas, benzothiazole, dithiocarbonate and formaldehyde) in goggles, scuba masks, nose clips, earplugs, fins, fin straps, and swimsuits [31]. Swimmer’s xerosis is a form of asteatosis dermatitis that presents with dryness, itching, and scaling of the skin, including the feet. Symptoms are more pronounced in the cooler winter months, and the dryness is exacerbated when swimming is followed by a prolonged, hot shower. The development of xerosis occurs when water evaporates from the outer layers of the skin; in addition, water dilutes the skin-produced

sebum. Pool water dermatitis is an allergic contact dermatitis to chemicals that are added to the pool water; it can affect the skin exposed to the pool water, including the feet. Daily treatment, by adding sanitizing chemicals, is typically performed in public pools to destroy and prevent microbial growth. Pool water dermatitis occurs after exposure to compounds containing chlorine and bromine: 1- bromo-3-chloro-5,5-dimethylhydantoin. It has also been observed to agents used to lower the pH of the swimming pool: sodium metabisulfite [2,32]. On the other hand, irritant contact dermatitis (ICD) results from direct injury to the skin seconds to minutes after exposure and does not involve the immune system cascades, thus it affects any athlete directly exposed to specific irritants and often produces symptoms [16]. Irritant contact dermatitis in athletes usually develops as a result of chronic friction. Use of caps and goggles that press tightly against the skin may lead to purpura formation [33].

Sun - related conditions

Accumulating evidence has shown that skin photoaging induced by UV-irradiation is associated with excessive production of reactive oxygen species (ROS), which can cause an imbalance of cellular oxygen levels, triggering oxidative stress and impairing the antioxidant defense system [34]. Surfing and swimming are activities associated with intermittent exposure to ultraviolet radiation (UVR), which is recognized as a causal factor in the development of non-melanoma (NMSC) and melanoma skin cancer (MSC). Use of SPF 30 or greater sunscreen and protective clothing is highly recommended to athletes. When counseling swimmers on sunscreen usage, one should advise the use of a sunscreen that contains SPF 30 or greater, is water resistant, and provides broad spectrum UVA and UVB coverage [15, 35-37].

Acne mechanica

Acne mechanica (AM) is a papulopustular eruption that simulates acne vulgaris, but is caused primarily by a combination of pressure, occlusion, friction, and/or heat. Stress on the skin appears to be the key element in AM rather than the inflammation and hyperkeratinization of the pilosebaceous unit seen in acne vulgaris. It is most often seen on the chin, jawline, forehead, neck, or shoulders and is characteristic for occurring predominantly beneath heavy protective equipment and exposed to friction [16].

Diagnostics of dermatoses in swimmers

Diagnostics of occupational skin dermatoses requires a detailed medical interview, dermatological examination and diagnostic tests. Contact dermatitis is inflammation of the skin induced by chemicals when they come in contact with the skin allergic contact dermatitis is a type IV delayed hypersensitivity reaction that requires prior sensitization with a genetic predisposition [38]. Patch testing is a very helpful, office- based procedure to elicit the culprit allergen. There are not many studies, particularly on facial contact dermatitis [39]. Skin patch test consist of 36 allergens (Nickel sulfate, Wool alcohols, Neomycin sulfate, Potassium dichloramate, Caine mix, Fragrance mix, Colophony, Paraben mix, Blank patch, Balsam of Peru, Ethylenediamine dihydrochloride, Cobalt chloride, p-tert- butylphenol formaldehyde resin, Epoxy resin, Carba mix, Black rubber mix, CI + Me- Isothiazolinone, Quarternium-15, Methyldibromo glutaronitrile, P-Phenylenediamine, Marcapto mix Formaldehyde, Thiomersal, Thiuram mix, Diazolidinyl urea, Quincoroline mix, Diazolidinyl urea, Quincoroline mix, Gold sodium thiosulphate, Imidazolidinyl urea, Budesonide, Hydrocortisone-17-butyrate, mercaptobenzothiazole, Bacitracin, Parthenolide, Disperse blue 106, 2-Bromo-2-nirtopropane 1,3 diol) as ready-to-use tape “TRUE test (Albio© Ltd) which may be ingredients of many products used among swimmers [40]. Daily dermatology procedures performed in dermatology and venereology clinics are microscopic examination with potassium hydroxide smear, Gram staining examination, slit skin smear test, allergy skin test (patch test and prick test), and skin biopsy. Skin specimens to support diagnosis of superficial mycosis can be used for both direct microscopic examination and fungal culture. Skin specimen collection taking in superficial mycosis on face, neck, armpit, groin, or genital can harm the patients [41]. Dermoscopy is a non-invasive magnification technique that allows for more detailed skin examination compared to the naked eye. Although dermoscopic images are not always indicative of underlying lesions, specific dermoscopic structures may facilitate their differentiation and recognition. One of the important variables that may affect dermoscopic presentation seems to be anatomical location. Among such special locations that require a peculiar dermoscopic approach are the facial and acral areas, as well as the nail apparatus region [42]. Dermoscopy should be considered as an auxiliary tool facilitating differential diagnosis of umbilical lesions, complementary to clinical evaluation [43].

Preventive recommendations for swimmers

Specialized sports clothing, proper skin care using emollients and limiting contact with chemicals by immediately rinsing chlorinated water and washing after training are key activities supporting skin health in swimmers [44]. For example, using footwear disinfectants and avoiding walking barefoot in public sanitary places are important measures in preventing fungal infections. Moreover, prevention includes maintaining skin hygiene through regular body washing and choosing underwear and clothing made of natural materials [45]. It is important to emphasize that sodium hypochlorite (1 per cent) placed conveniently near swimming pools and gymnasiums has been proven of value in preventing infection [46].

Treatment Options

Treatment of dermatoses in swimmers depends on the disease and the factor causing the skin lesions. Topical moisturizing products are widely used to alleviate the problems associated with xerotic skin. Their use affects many properties of the stratum corneum (SC) in a complex and interrelated manner. The range of measurement techniques available to researchers has increased in recent years [47]. On the other hand, we treat infections according to the cause. To prevent sunburn during swimming should be remembered that one application of either an inorganic or an organic sunscreen reduced the erythema caused by UVB during a day with physical activity and bathing [48].

Conclusions

Preventing dermatoses in swimmers requires a comprehensive approach that combines precise diagnostics with effective preventive measures. Swimmers should be educated about the potential occurrence of dermatoses. Proper skin care is crucial, including the use of emollients, protective creams and quick removal of chlorine residues from the body surface after training. Regular dermatological examinations enable early detection and treatment of skin problems, which helps minimize the risk of infection and irritation.

Disclosure

Author's contribution: Conceptualization, PŁ, and JT; methodology, PŁ; software, EJ; check, PŁ, EJ and JT; formal analysis, PŁ; JT; investigation, JT resources, PŁ; data curation,

EJ; writing - rough preparation, PŁ; writing - review and editing, PŁ; visualization, EJ; supervision, EJ project administration, JT

Supplementary Materials: They have not been provided.

Funding Statement: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflict of Interest: The authors declare no conflict of interest. All authors have read and agreed to the published version of the manuscript.

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