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Infectious skin diseases in contact sports - a literature review

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ABSTRACT

Introduction: Infectious skin diseases in athletes, particularly occur in contact sports like wrestling, football, and rugby and are caused by a variety of pathogens, including: bacteria, viruses, and fungi. These infections are common due to direct skin-to-skin contact and can lead to missed training and insufficient physical outcomes in competitions. The most frequent pathogens are methicillin-resistant *Staphylococcus aureus*, *Trichophyton*, and *Herpes simplex* virus. Skin infections often affect areas like the head, face, and arms and can be transmitted through contaminated equipment or direct contact. Prevention involves good hygiene, early detection, and proper disinfection of sports equipment. Effective management and isolation of infected athletes are key to reducing transmission.

Purpose of the work: The aim of this review is to discuss common skin infections in contact sports, their prevalence, clinical features, diagnosis, treatment, and prevention strategies, categorized into bacterial, viral, and fungal infections.

Materials and methods: A comprehensive analysis of research articles available on PubMed, Google Scholar, Web of Science, Embase, and Scopus was conducted using search terms related to: "contact sports," "skin infections," "infective skin diseases," "athletes" and "prevention."

Results: Infectious skin diseases pose significant risks to athletes in contact sports due to close physical interaction, shared equipment, and skin injuries. Effective prevention requires strict hygiene, prompt wound care, and education on avoiding shared items. Awareness among coaches and athletes is crucial, as proper hygiene practices can reduce outbreaks. More research is needed to better understand transmission and to improve prevention strategies in contact sports.

Keywords: infectious skin diseases, contact sports, prevention, adverse effects.

INTRODUCTION

Infectious skin diseases are associated with inflammatory processes in the skin and subcutaneous tissue, caused by pathogens such as bacteria, viruses, and fungi. In athletes, the skin is the most common site for the development of infections [1]. Such infections are commonly encountered in sports, with contact athletes such as: wrestlers, football players, and basketball players being at higher risk of infection than those participating in non-contact sports due to direct skin-to-skin contact with colonized opponents [2]. The most common sports disciplines where skin infections occur are wrestling, judo, sumo, rugby, and American football [1]. Wrestling and football coaches receive educational materials about MRSA more frequently than coaches of other sports. Furthermore, wrestlers and football players are more often screened for skin infections by their coaches than high school athletes participating in other sports [3, 7]. Infectious skin diseases account for 8.5% of all health-related issues among high school wrestlers and 20.9% among college wrestlers and they lead to interruptions in training [4]. Skin infections account for approximately 20% of all sports-related incidents leading to time loss from practice among wrestlers, particularly due to *Herpes simplex* infections (40.5%), bacterial infections (24,9%) and dermatophytosis (22.1%) [3, 7]. Typically, around 70% of athletes lose less than one week of practice due to such infections [4, 7].

In addition to missed training sessions, these diseases are associated with disqualification from competitions and the need for antimicrobial therapy [5, 6]. The most common pathogens causing skin infections in athletes are methicillin-resistant *Staphylococcus aureus* (MRSA), *Trichophyton*, Group A *Streptococci*, methicillin-sensitive *Staphylococcus aureus* (MSSA), and *Herpes simplex* virus [1]. Among high school wrestlers, the most common infectious skin disease is impetigo (30%), followed by *Herpes simplex* virus infection (20%) and dermatophytosis (20%). In college wrestlers, the most frequently identified infections are herpes virus (47.1%), impetigo (36.8%), tinea corporis (7.4%), cellulitis (5.9%), and infections caused by methicillin-resistant *Staphylococcus aureus* (MRSA) (2.9%) [4].

In contact sport athletes, bacterial skin infections are most commonly caused by group A *Streptococcus* and *Staphylococcus* species, including MRSA. A 2016 study found that 0.4-0.6% of high school football players and 0.9% of wrestlers contract CA-MRSA (community-associated methicillin-resistant *Staphylococcus aureus*) each season [2]. These infections often present as impetigo, erysipelas, cellulitis, folliculitis, furuncles, carbuncles, and abscesses [5, 6, 8]. Impetigo, erysipelas, and cellulitis are primarily caused by *Streptococcus* or *Staphylococcus* species, while the most common etiologic patogen of folliculitis and furuncles is *Staphylococcus aureus* [6]. Diagnosis is typically based on clinical presentation. However, in cases resistant to treatment, cultures may be necessary. If systemic symptoms of infection are present in erysipelas or cellulitis, laboratory tests and blood cultures might be required [5, 6]. A common disease among wrestlers is herpes gladiatorum, a contagious skin infection caused by the *Herpes simplex* virus, most often HSV-1 [5, 6, 8]. Viral herpes infections are often misdiagnosed as other conditions, making microbiological testing essential [8]. Diagnosis is usually based on clinical presentation, but viral culture [8] and PCR (Polymerase Chain Reaction) test to detect viral DNA can also be performed [5, 6, 8]. Other viral skin diseases transmitted through direct contact that may occur in athletes include verrucae vulgaris (common warts) and molluscum contagiosum [5, 6, 8]. Dermatophytoses, fungal infections of the skin, in wrestlers are most commonly caused by *Trichophyton tonsurans*. Dermatophytes infect the epidermis, leading to a condition known as tinea gladiatorum [6, 8]. Diagnosis can be aided by a potassium hydroxide (KOH) preparation test, culture, or skin biopsy [5, 6, 8]. The *Malassezia furfur* fungi, in turn, cause tinea versicolor and can be diagnosed using a UV lamp (Wood's lamp) or microscopy [5].

Skin infections in wrestlers are most commonly localized on the head, face, neck, and arms [4, 1]. Bacterial infections manifest as papules and pustules, honey-colored crusts (impetigo), or painful, erythematous nodules filled with pus (abscesses, furuncles). Sometimes, these infections can lead to disseminated infection and systemic symptoms [5, 6]. On the skin, they appear as well-demarcated, red plaques (erysipelas) and erythematous patches (cellulitis) [5, 6]. Erysipelas and cellulitis cause swelling, warmth, and redness of the skin, often accompanied by fever and chills [5]. Primary infection with the HSV virus presents as burning, tingling vesicles that may rupture and ulcerate [5, 6, 8], accompanied by systemic symptoms [6, 8]. Secondary infections typically result in milder symptoms, with less severe skin lesions [6, 8]. *Dermatophytoses* manifest as ring-shaped lesions with scaly borders [5, 6].

Skin infections in contact sports athletes can be transmitted indirectly through contaminated sports equipment and wrestling mats [4, 6]. However, the most common mode of transmission among wrestlers is direct skin-to-skin contact with an opponent [4, 6, 8], with skin injuries or wounds increasing the risk of infection [6, 8]. Sweaty and damaged skin promotes the development of pathogens and their invasion through the skin barrier [1]. Risk factors for CA-MRSA infection include direct physical contact, sharing equipment and lockers, and skin lesions [1, 2]. To reduce the risk of infection, sports equipment should be properly disinfected. Additionally, maintaining appropriate hygiene among athletes, early identification of skin infections, and isolating infected individuals are crucial measures [4].

BACTERIAL INFECTIONS IN CONTACT SPORTS

Skin and soft tissue infections caused by *Staphylococcus* and *Streptococcus* are some of the most common conditions affecting humans. These bacterial infections, especially CA-MRSA, can present as various conditions, including impetigo, erysipelas, cellulitis, folliculitis, boils, carbuncles, and abscesses. [9, 10, 11, 16]

MRSA and MSSA *Staphylococcus aureus*

Gram-positive and coagulase-positive, *Staphylococcus aureus* is a member of the *Staphylococcaceae* family. It is a spherical bacterium that forms clusters that resemble grapes and has a diameter of about 1 μm. *S. aureus* is a commensal that frequently appears asymptomatically on human body parts like skin, skin glands, and mucous membranes, including healthy people's noses and guts. Research has indicated that approximately 20% of people are intermittent and persistent nasal carriers of *S. aureus*, while 50% of people are noncarriers. As a result, this colonization creates a reservoir for the pathogen, greatly increasing the likelihood of infections. [20]

Methicillin-resistant *Staphylococcus aureus* (MRSA) was first described in the 1960s as a nosocomial pathogen. In the early 1980s, infections based on community-associated MRSA (CA-MRSA) began emerging. These infections were related to the spread of MRSA from hospitals into the larger community. [11, 12] Today the prevalence of CA-MRSA infections are on the rise and becoming a major public health threat. [11, 13] This organism has been identified as the main pathogen responsible for skin-related infections in numerous emergency rooms across the United States. [11, 14]

Genes that encode for the virulence factor Panton-Valentine leukocidin are commonly expressed by CA-MRSA strains. This cytotoxin has been linked to necrotizing pneumonia and soft tissue infections by causing destructive holes in leukocytes. [11, 15]

People at greater risk to get infected by CA-MRSA are athletes, day care attendees, military personnel, inmates at correctional facilities, males having sex with other males, persons living in crowded settings. [11] In the NFL, MRSA infections have been a recurring issue. In 2013, three Tampa Bay Buccaneers players contracted MRSA, with one experiencing a relapse. Between 2006 and 2008, 33 cases were reported, and in 2003, eight infections occurred among St. Louis Rams players due to turf abrasions, with some opposing players also affected, likely from in-game transmission.

Similar outbreaks have been linked to direct contact or shared items like gym equipment, towels, razors, and hygiene products in sports such as wrestling, rugby, basketball, baseball, and canoeing. [10]

SSTIs accounted for 24–9% of all cutaneous infections reported in NCAA wrestlers between 1993 and 2004, making them the second most common cause of missed practice time. [17, 18] Methicillin-resistant *Staphylococcus aureus* (MRSA) SSTIs linked to the community are becoming more common in wrestlers and athletes in general. [17] *S. aureus* infections are typically treated with semisynthetic penicillins, but MRSA is resistant to these, including cephalosporins, making antibiotics like dicloxacillin and cephalexin ineffective. Culturing and antimicrobial testing help identify MRSA infections early. Community-acquired MRSA is usually treatable with tetracyclines, trimethoprim-sulfamethoxazole, and clindamycin. Nonpurulent MSSA infections (erysipelas, cellulitis, folliculitis) can be treated with cephalexin or dicloxacillin. Purulent MSSA infections (furuncle, carbuncle, abscess) should be treated by surgical incision and drainage and if there is a need with cephalexin or dicloxacillin. [9, 10, 11] Infected individuals should follow strict hygiene practices to prevent spread. While chlorhexidine soap and mupirocin nasal treatment are recommended for recurrence, their effectiveness in community outbreaks is not well-established. [10]

Folliculitis, an infection of hair follicles often caused by *S. aureus* or Gram-negative bacteria, can occur after skin trauma, such as during mud wrestling. It typically clears on its own within days, but treatment with warm compresses, topical antibacterials, or astringents may help prevent progression to furuncles. [10, 17] Furunculosis is a *S. aureus* infection of hair follicles, sebaceous glands, or damaged skin, often developing from folliculitis. [10, 17]

Staphylococcal skin infections in high school football teams and river-rafting guides are linked to direct contact, with injuries increasing the risk. Wearing full-body uniforms can help prevent skin abrasions. Infected athletes should avoid contact sports until healed, and shared containers of ointments or powders should be avoided. [10] Treatment includes warm compresses, benzoyl peroxide, oral antibiotics, and, for large lesions like carbuncles, surgical drainage. [10]

Streptococcus pyogenes

The Gram-positive host-adapted bacterial pathogen *Streptococcus pyogenes* (Group A *Streptococcus*; GAS) causes minor human infections like impetigo and pharyngitis as well as uncommon but serious invasive illnesses like necrotizing fasciitis, streptococcal toxic shock-like syndrome (STSS), and septicemia. [21]

Impetigo, a contagious skin infection caused by *Staphylococcus aureus* or *Streptococcus pyogenes*, is common in athletes like wrestlers, swimmers, and football players. It begins with superficial vesicles or bullae that rupture, forming honey-colored crusts. The infection spreads rapidly and can lead to deeper complications. [10, 17]

Treatment involves cleaning and debriding with hydrogen peroxide, along with oral or topical antibiotics targeting the cause for example mupirocin 2% ointment [9, 10]. More acute forms of impetigo can be treated with oral clindamycin, cephalexin, dicloxacillin. [9, 17]. Without proper care, the contagious nature of the infection can lead to outbreaks among athletes. [10]

Corynebacterium minutissimum

Erythrasma, caused by *Corynebacterium minutissimum*, presents as reddish-brown patches with fine scaling, typically in the groin or armpits, and is often mistaken for a fungal infection. The lesions are well-defined and may itch. Under a Wood's light, they show a coral red fluorescence, aiding diagnosis. Treatment includes topical cleansers, germicidal agents, or oral and topical antibiotics. Prevention involves using antibacterial soaps and wearing loose clothing, though the infection commonly recurs. [10]

Pitted keratolysis, also called "stinky foot syndrome," is an asymptomatic skin infection caused by *Corynebacterium minutissimum* and other bacteria. Common in athletes participating in basketball, tennis, volleyball, and track, it appears as malodorous pits up to 7 mm on weight-bearing areas, especially the feet and toes. [10, 12] Pitted keratolysis can improve quickly by reducing moisture with wicking socks and drying agents. Topical antibiotics are commonly used, while resistant cases may need oral erythromycin or mupirocin. Botulinum toxin is effective for cases linked to excessive sweating. [10, 11]

Pseudomonas aeruginosa

Hot tub folliculitis, caused by *Pseudomonas aeruginosa*, is a skin infection linked to exposure to contaminated water in hot tubs, whirlpools, and swimming pools. It often occurs when tubs are not properly cleaned or maintained, as seen in cases where multiple people used a tub that hadn't been cleaned for several days. The infection can also affect athletes, such as college football players, after using whirlpools for injury treatment. Preventing this infection requires careful monitoring of water quality, including temperature, pH, disinfectant levels, and chlorine concentration. Hot tub folliculitis is usually self-limiting, resolving within 7 to 10 days without the need for specific treatment. [10]

BACTERIAL SKIN INFECTIONS IN WATER SPORTS

Water can carry a variety of infectious agents, which presents a risk to athletes engaged in water sports, depending on the type of activity and the cleanliness of the water. Athletes may contract waterborne diseases through extended contact with water or by swallowing contaminated water during events. Examples of such infections include leptospirosis, otitis externa, and bacterial colitis. [10, 12]

Leptospirosis is transmitted through contact with infected animals' urine or tissue, or by exposure to contaminated water. It often starts as a mild illness with fever, chills, headache, and muscle pain. However, in 10% of cases, it can progress to a severe form, leading to liver inflammation, kidney failure, bleeding, and possibly death. [10]

Water sports enthusiasts, especially those in natural water sources, are at higher risk for leptospirosis. Outbreaks have occurred among rafters, swimmers, kayakers, and triathletes exposed to contaminated water. Treatment includes antibiotics like doxycycline, amoxicillin, or ceftriaxone, while preventive measures, such as protective clothing, can reduce exposure to contaminated water. [10, 11]

Otitis externa, or swimmer's ear, is an outer ear canal infection often seen in water sports athletes. Those exposed to polluted water, like swimmers, divers, and kayakers, are particularly at risk. The condition is mainly caused by *Pseudomonas aeruginosa*, but can also be triggered by *S. aureus* or *Aspergillus*. [10, 12] Prolonged water exposure softens ear canal tissue and removes ear wax, which protects against bacteria and fungi. Treatment involves cleaning and drying the ear, along with topical steroids and antimicrobials. Severe cases may require systemic therapy. [10]

DIAGNOSTIC OF BACTERIAL SKIN INFECTIONS

An SSTI (skin and soft tissue infection) is typically diagnosed clinically. Uncomplicated SSTI cultures rarely change management, so they are not usually advised. [17] The clinician must maintain a high index of suspicion when confronted with acute and wide-spread skin and soft tissue infections. It is important to culture all purulent skin lesions. The information obtained from the culture guides antibiotic selection and provides information. [11] According to consensus guidelines, cultures are advised when a purulent lesion is present along with at least one of the following characteristics: antibiotic treatment, indications of systemic toxicity, multiple or large lesions, bite as the cause, connection to water exposure, lack of response to initial treatment, or occurrence during a suspected outbreak. [17, 19]

A general review of popular medical databases like Medline, Pascal, and Science direct showed that the athletes affected by bacterial and viral infections were between the ages of 7 and 38, with an average age of 23. The sex of these athletes was covered in 45 articles. The majority of them (n = 42) were men. Ten articles made reference to female athletes. The most mentioned sports were combat sports (13. 24%): wrestling, sumo, judo, mixed martial art (MMA). American football (11. 20%), soccer (7. 13%), rugby (4. 8%) were also included. Many other sports were rarely mentioned, presenting as singular cases. [22]
Methicillin-resistant *Staphylococcus aureus* (MRSA) was the most commonly cited infectious agent that caused outbreaks that were reported (27.4% of articles), as well as *Trichophyton. Leptospira* was one of the additional agents that caused infections in competitive sports. Other bacteria mentioned were *S.pyogenes*, MSSA, *Neisseria meningitidis*. [22, 23]

VIRAL SKIN INFECTIONS IN CONTACT SPORTS

Herpes simplex virus

The human herpesvirus family's alpha subfamily includes the *Herpes simplex* virus (HSV), which includes both HSV-1 and HSV-2. These viruses cause extensive outbreaks of a number of herpes-related illnesses. [3c] Between 94 and 97 percent of HSV infections in the context of wrestling are type 1 infections. [26] The term Herpes gladiatorum (HG), coined by Selling and Kibrick in 1964, gained widespread recognition following a notable outbreak at a 28-day wrestling camp in 1989, in which 60 out of 175 wrestlers contracted the virus. The Public Health Department closed the camp as a result of this. [26] Similar incidents occurred in 1999, 2001, and 2007, leading to the closure of the camp on each occasion. [27]

The primary method of HSV transmission is direct skin-to-skin contact. It has been shown through research that surfaces such as training mats and other objects do not significantly contribute to the virus's spread. [28] Around 29% to 30% of high school wrestlers are either infected with or carriers of HSV, but only 3% are aware of their infection. [27]

In wrestling, more than 70% of herpes outbreaks affect the face. Infections of the fingers or thumbs (herpetic whitlow), along with other areas of the body that are often abraded, make up the remaining 30%. Pre-existing skin conditions, such as eczema, can increase the risk of HSV infection. Ocular involvement can occasionally occur, with herpes keratitis (corneal infection) potentially causing scarring. Recurrent outbreaks can result in permanent corneal clouding, sometimes requiring a corneal transplant to maintain vision. In rare, severe cases, retinal necrosis can lead to blindness. Primary herpes gladiatorum (HG) outbreaks are often accompanied by systemic symptoms, such as fatigue, mild fever, sore throat, and swollen, tender lymph nodes in the neck. Within 1 to 2 days, small patches containing 3 to 10 vesicles (blisters) will form, typically with only slight redness around the base. Most infections (90%-93%) occur within 8 days of exposure. The virus replicates in the ganglia and spreads along sensory nerve tissue. [27, 28] Shorter durations and fewer vesicles are common in recurrent HG outbreaks. New outbreaks that impact the same dermatomal or peripheral nerve areas as earlier ones follow the same pattern when the dormant virus in the ganglia is reactivated. [27, 29] Systemic symptoms are much less common in recurrent cases, and these outbreaks usually last 7 to 10 days. Antiviral medications can reduce the duration of illness by 2 to 5 days, helping athletes return to competition more quickly. [27]

It is highly recommended to conduct microbiological tests for HSV-1 and HSV-2, as herpes gladiatorum (HG) is frequently misidentified as other skin infections in wrestlers. During the initial visit, doctors may diagnose up to 90% of HG cases incorrectly. Direct testing of active lesions is preferred over serological techniques. The HSV polymerase chain reaction (PCR) and viral culture are both dependable methods with almost perfect specificity and high sensitivity. Either test can be appropriate depending on the clinical circumstances, but viral culture is more cost-effective, while PCR typically offers faster results. [27]

Oral antiviral therapy should be started as soon as herpes gladiatorum is suspected, and athletes who are infected must be isolated from others and any shared equipment until the infection has been fully cleared. While antiviral medications accelerate the resolution of the outbreak, it may take up to 10 to 14 days for complete recovery. This treatment not only helps to resolve symptoms more rapidly but also reduces the risk of spreading the infection to other athletes. [25] It is still difficult to stop HSV from spreading because almost 87.3 percent of outbreaks are subclinical and frequently go undetected. Many athletes who are infected but do not exhibit any symptoms may unintentionally contribute to large outbreaks at inappropriate times, like during training camps or postseason competitions. It has been demonstrated that taking oral valacyclovir lowers the risk of contracting HSV and can help stop HG outbreaks in the future. Valacyclovir has been shown to dramatically reduce the risk of both acquiring HSV and experiencing an HG outbreak, whether in wrestlers who are already infected with the virus or those who have never been infected. [25, 27]

Human immunodeficiency virus

AIDS, also known as acquired immunodeficiency syndrome, is a potentially fatal condition caused by the *Human Immunodeficiency* virus (HIV), a rare blood-borne viral pathogen. HIV transmission through contact sports has been documented in one instance. According to estimates, there is a less than 1 in 85 million chance of HIV transmission during American football games. [27, 31]

Sexual contact, parenteral exposure to blood or blood components, sharing of needles, perinatal transmission from an infected mother to a fetus, and contamination of open wounds or mucous membranes by infected blood or bodily fluids are among the modes of transmission. Fist fighting episodes involving bloody injuries have been linked to at least two cases of HIV transmission. These reports highlight the potential dangers that athletes face and stress the need for safety measures during situations where blood exposure could happen. [30]

Although there is little chance of HIV transmission in contact sports, universal precautions against blood-borne infections must still be taken. Blood on uniforms, mats, or other surfaces should be cleaned with soap and water, bleach, hydrogen peroxide, or comparable disinfectants. Any bleeding wounds should be appropriately covered. When handling bodily fluids, healthcare personnel should always wear gloves. [30]

Human papillomavirus

Warts are scaly nodules that can develop anywhere on the body, but they most frequently affect the hands and feet. They are brought on by one of the *Human papillomaviruses*. Although warts usually don't hurt, they can if there is enough local trauma or abrasion to the area. [27] Because plantar warts grow into the foot and become callused rather than rising above the surface, they often cause pain. [32]

The effects of perspiration make athletes more susceptible to infection because moist environments foster the growth of verrucae. Warts are more likely to develop in athletes who participate in sports like gymnastics, track, football, tennis, baseball, and wrestling where calluses are likely to form. In an athletic environment, contaminated floors—like those in shower rooms or swimming pools-are likely to spread plantar warts, whereas contaminated weightlifting equipment or gym equipment are likely to spread hand warts. When participating in contact sports, warts should always be covered to stop the spread of HPV. In the shower and locker room, athletes who are prone to warts should think about wearing rubber sandals and applying drying powders to their feet. [30]

Numerous treatments, such as curettage, cryotherapy, duct tape, cantharidin, podophyllin, tretinoin, and topical acid preparations, are successful. Because it's quick and easy, curettage and covering the lesion is the preferred treatment for the majority of athletes. [27, 30]

Molluscum contagiosum virus

Molluscum contagiosum is caused by the *Molluscum contagiosum* virus (MCV), a double-stranded DNA poxvirus. The typical lesion is round, dome-shaped, and pinkish-purple in color. It typically has no regional adenopathy or surrounding erythema. [30, 33] The duration of the incubation period is two weeks to six months. The molluscum contagiosum virus only infects keratinocytes, and skin lesions are restricted to the epidermis without spreading throughout the body. [33]

When the papule ruptures, a cheesy substance with a high virus content is produced. This substance can cause the rash to spread or infect other people at risk. Groups of people who are often in close physical contact with one another are more likely to become infected with molluscum contagiosum. In contact athletes and in the genital area of sexually active people, lesions are more common on exposed skin. [27]

Infections that are left untreated typically go away on their own in six to nine months. Patients with untreated HIV infection or compromised cellular immunity may experience a prolonged or severe infection. [30] The current course of treatment consists of systemic therapy, topical medications, and the physical removal of the molluscum. Cryotherapy using liquid nitrogen or curettage are the main methods used for physical removal. Local anesthesia may be necessary for this, which is typically painful. There may be scarring after surgery. [33] Salicylic acid, potassium hydroxide, podophyllotoxin, and tretinoin gel or cream are a few topical treatments. To help prevent infection, protective clothing and proper hygiene are advised. There is little scarring when molluscum is treated with topical trichloroacetic acid. [27, 30, 32, 33] Children who are afraid of pain may find that oral cimetidine is a safe substitute for physical removal. It has been demonstrated that the DNA polymerase inhibitor cidofovir works well for individuals with lower frequency; however, when released, it may result in nephrotoxicity and neutropenia. [33]

FUNGAL SKIN INFECTIONS IN CONTACT SPORTS

Tinea

Ringworm, also known as tinea, is a term used to describe superficial dermatophyte infections that are contracted by touching contaminated surfaces or by coming into contact with other people or animals. This pathogen is more likely to survive in warm, humid conditions. [34] Skin infections are commonly caused by *Microsporum*, *Trichophyton*, and *Epidermophyton* fungi, which are categorized as dermatophytes or tinea due to their need for keratin, a component abundant in skin, hair, and nails, for their growth. In some instances, superficial skin infections are attributed to non-dermatophyte fungi, like *Malassezia furfur* in the case of pityriasis versicolor, and *Candida* species. [30, 32] The risk of infection is higher for athletes who play close-contact sports like football, rugby, and wrestling. Multiple outbreaks involving *Trichophyton tonsurans* have been documented among high school and collegiate wrestlers, despite the fact that *Trichophyton rubrum* is the most common causative organism. [30]

Tinea corporis in contact sports is characterized by itchy, annular plaques that frequently have vesicles around the edges. [35] Although the infection can occur anywhere on the body, it most frequently occurs on the feet, where vesicular presentations are most common, on the groin, and under skinfolds. Anatomical location is used to categorize them. [34] The symptoms usually start as a tiny red spot that develops into an annular lesion up to 5 to 8 cm in diameter 3 to 5 days after exposure. [27]

Exposure to desquamated cells or direct contact can both result in transmission. The skin breaks to allow for inoculation. After the outermost layers of skin are invaded, germination takes place. The majority of cases in athletes are caused by contaminated floors in the locker room or showering facilities, shared towels, increased moisture from perspiration, and skin injuries. [30, 32]

There are several approaches for clinicians to make this diagnosis. With a 15-blade scalpel, you may scrape the lesion's leading edge. With a 10% or 20% potassium hydroxide solution, direct inspection is carried out, the lysing of epidermal cells makes the septated fungal hyphae visible. [34] Fungal culture, skin or nail biopsy, and Wood's lamp examination are other diagnostic techniques. [32]

It has been demonstrated that prophylactic therapy of tinea gladiatorum with 100 mg of fluconazole once weekly or intermittent doses of oral itraconazole is effective. Antifungals are useful preventative medicines, but it is not feasible to provide universal prophylaxis for every team member due to the expense, the elevated risk of microbial resistance, and the possible side effects of the drugs. [30] Although it hasn't been well investigated, ketoconazole 2% shampoo could aid in reducing transmission. [27] Proper hygiene and regular examination of the scalp help avoid the development or recurrence of the disease. [36] All types of superficial fungal infections except the scalp are treated topically with imidazoles (clotimazole, ketoconazole) or allylamines. In extensive infections, when local treatment is ineffective, systemic treatment with imidazole or terbinafine is used. [34]

RISK FACTORS OF SKIN INFECTIONS IN CONTACT SPORTS

Sports often involve physical contact, a risk of injuries, close proximity to others, and exposure to bodily fluids, all of which create opportunities for transmission. [10, 11, 23]
For example, in boxing, cuts to the face often occur during a fight. In such a situation, according to the rules, the wound should be dressed with sterile gauze, but most often a towel that has previously been in contact with the boxer's sweat or was used to wipe water from the mat is used for this purpose. Such behavior carries a huge risk of infection. [32] Additionally, shared equipment and surfaces can further increase the likelihood of spreading infections. Sports-related risks typically involve injuries such as muscle strains, ligament sprains, broken bones, and concussions.

Infectious agents can be transmitted in sports through various pathways. The primary modes of spread include physical contact, shared surfaces or objects, respiratory droplets, airborne particles, and exposure to a common source of infection.

Direct-contact transmission occurs through physical contact between individuals, while indirect-contact transmission happens when a person touches contaminated items like equipment, towels, or clothing. Droplet transmission, a form of indirect contact, occurs when infectious droplets from coughing, sneezing, or talking land on a person's eyes, nose, or mouth after traveling a short distance. Common-source transmission occurs through contaminated items like food, water, or shared equipment. Airborne transmission involves tiny infectious particles that remain in the air and are inhaled over time. [10, 11, 23]

PREVENTION METHODS FOR SKIN INFECTIONS

To prevent infections employees and athletes should be trained. There are a few rules to follow. Make hand washing mandatory. Instead of using bar soap, use soap dispensers. After working out, take a shower right away. Refrain from sharing personal items such as combs, brushes, water bottles, towels, and shavers. [11] It has been documented that judo athletes have been spreading fungal infections by sharing electric razors. [38] In the prevention of infectious diseases in athletes, it is also important to maintain the proper cleanliness of personal items such as bedding or towels. According to the recommendations, these materials should be washed in hot water, using detergent. The guidelines state that the washing temperature should not be lower than 50 degrees Celsius. As directed by the manufacturer, clean exercise equipment, hot tubs, showers, and whirlpools. Make regular cleaning plans for the equipment. As directed by the manufacturer, wash and dry your clothes. Inform medical personnel of any skin lesions. Take care of and cover wounds appropriately. Antibiotics should be used properly. [11, 27, 37]

The investigation and disinfection of bacteria and fungi in sports fitness center at Chia-Nan University of Pharmacy and Science in Taiwan used ClO2, WAHW, ZnO, commercial disinfectant (Savlon, ITC Limited) (Weakly Acidic Hypochlorous Water), and water to examine the efficacy of bioaerosol disinfection in a fitness room following use. According to the findings, WAHW was superior for disinfecting bacteria, whereas ClO2 was more efficient at inactivating fungus. As may be expected from physical scrubbing rather than disinfection, water proved the least effective in eradicating bioaerosols from the air. [24]

SUMMARY

Bacterial infections, particularly those caused by *Staphylococcus aureus* (including both MRSA and MSSA) and *Streptococcus pyogenes*, pose significant risks to athletes engaging in contact sports. Skin infections are a significant concern due to the close physical interactions among athletes. The prevalence of community-associated MRSA (CA-MRSA) has increased, leading to various skin and soft tissue infections, including impetigo, folliculitis, furuncles, abscesses, carbuncles, erysipelas, and cellulitis. Common pathogens also include herpes simplex virus, human papillomavirus, molluscum contagiosum, and dermatophyte fungi causing tinea. The close contact inherent in sports, combined with shared equipment and skin injuries, creates an environment conducive to infection spread. Risk factors for transmission include injuries, skin abrasions, and moist environments that facilitate pathogen growth. Effective prevention strategies, such as stringent hygiene practices, prompt wound management, and education on the risks of sharing personal items, are crucial.

Additionally, awareness and prompt isolation of infected individuals are essential to prevent outbreaks, ensuring a healthier environment in athletic settings.

Recognizing the significance of awareness regarding skin infections among athletes is essential, particularly for those in contact sports. Pathogens such as *Staphylococcus aureus*, including MRSA, *Streptococcus pyogene*s, *Herpes simplex* virus, HPV, molluscum contagiosum and dermatophytes responsible for tinea can all lead to significant health issues. These infections often spread through direct skin-to-skin contact, shared equipment, and contaminated surfaces, making athletes particularly vulnerable. Infectious diseases notably affect athletes - accounting for a significant percentage of health-related issues and causing interruptions in training and competition. A 2012 study found that 61% of high school coaches and athletic directors participating in the research received educational materials about MRSA, and only 32% indicated that their schools had guidelines for managing skin infections in athletes. Additionally, 38% of respondents reported that hand sanitizers were available for athletes during practices or competitions. In football, 44% of helmets and 40% of protective pads are not cleaned regularly, while 25% of wrestling coaches do not ensure regular cleaning of head gear, although 100% of wrestling mats are cleaned daily [3]. Increasing awareness about the symptoms, transmission methods, and risk factors associated with these infections can help athletes take proactive measures. Implementing strict hygiene practices, such as immediate showering after practice, avoiding the sharing of personal items, and effectively managing injuries, is vital in minimizing the risk of outbreaks. Educating athletes about the symptoms and transmission pathways not only helps reduce infection rates but also fosters a safer competitive environment, allowing athletes to focus on performance and health.

More research is needed on the transmission of pathogens among athletes and the risk factors for infections in order to develop effective methods for preventing skin infections in contact sports. Additionally, it is important to investigate whether increasing knowledge about modes of transmission and infection prevention, as well as raising awareness about health consequences, can reduce the incidence of infectious skin diseases among contact sport athletes.

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