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42.1 Introduction

Susceptibility to infectious diseases can be increased by immune system alterations after prolonged and intensive physical activity. According to several studies, the appearance of alterations in the immune system could increase the risk of infections—especially of the respiratory tract—during the 1–2 weeks after heavy training.

Regarding the relationship between physical activity and respiratory tract infections, some researchers support—through the J-shaped hypothesis—that moderate exercise strengthens the immune system, whereas heavy and prolonged ones have an inhibiting effect and increase the risk of URTI (upper respiratory tract infections). Thirty-three percent of the athletes that completed the marathon presented signs of URTI during the following 2 weeks.

Other researchers describe a “window of decreased host protection” several hours after heavy exercise, when the athlete is more prone to suffering from clinic or sub-clinic diseases, a risk that will increase by repeated cycles of high intensity exercise. Further research is necessary in order to accurately determine the effects of

exercise on the immune system. However, all the studies describe some objective alterations of the quality and quantity of several types of blood cells, such as neutrophilia and lymphocytopenia and a decrease of natural killer (NK) cells after heavy exercise.

A suppression of the neutrophil function—an important component of the innate immune system that contributes to the phagocytosis of many bacterial and viral pathogens and the release of immunomodulatory cytokines—has been observed during periods of heavy training, together with a decrease of salivary IgA levels and minor reductions of IgG. The secretory immune system that is present in the mucosal tissues of the upper respiratory tract constitutes the first barrier to colonization by pathogens. Secretory IgA prevents them from entering the body by inhibiting attachment and replication.

Serum cortisol concentrations—which can be associated with many of the immunosuppressive changes during recovery—are elevated above control level for several hours after prolonged running at high intensity.

On the other hand, the relationship between heavy physical activity, microbiome alterations and their role in infectious diseases in athletes has attracted the attention of researchers. Intestinal microbiota plays an essential role in vital functions such as digestion, nutrients absorption, and protection from ingested pathogens, among others. Some researchers claim that intestinal microbiota

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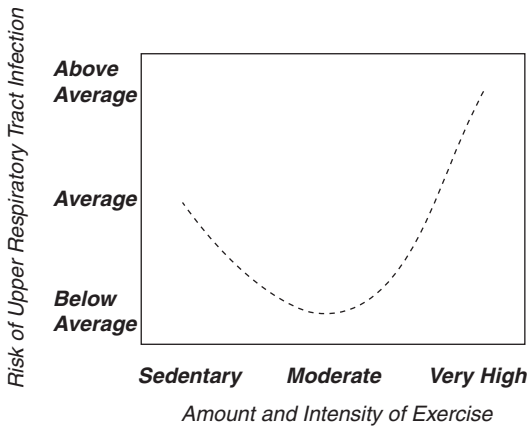


Fig. 42.1 J-shaped model of relationship between varying amounts of exercise and risk of upper respiratory tract infections. This model suggests that moderate exercise may lower risk of upper respiratory tract infection, while exercises amounts may increase the risk

can alter homeostasis at distal mucosa sites such as the respiratory tract mucosa.

Long distance runners know the high prevalence, 30–50% of gastrointestinal disorders during effort, such as dizziness, nausea, vomiting, and diarrhea. Symptoms are usually mild and do not affect performance, but together with the increase of permeability of the intestinal barrier, they might facilitate the passage of bacteria and gram-negative organisms and cause remote infections (Fig. 42.1).

42.2 Sport-Specific Strategies

A variety of infectious diseases commonly occur in sports. The vast majority of these are relatively minor and lead to minimal morbidity. The most common medical presentation in elite athletes is upper respiratory symptoms (URTIs), which generally happen in outdoor and cold environments and are most commonly caused by viruses: in 25–60% of cases the pathogens are rhinoviruses and coronaviruses. Non-infectious causes of URTI illness symptoms include allergic rhinitis and asthma among others.

Fungal and viral skin infections are more frequent indoors and in contact-related sports, indoor ambient air can contain allergens and pol-

lution that can cause or exacerbate asthma and other respiratory ailments when susceptible individuals are exposed to these environments. Many factors should be considered indoors, such as adequacy of ventilation, humidity level, presence of allergens, presence of wall-to-wall carpeting, and upholstered furniture.

Frequent travel, which is often common in sports, can also increase the risk of illness; a good strategy for prevention is proper planning before traveling. It should be considered whether any specific vaccinations are needed when teams are traveling. Examples may include yellow fever, typhoid fever, Japanese encephalitis, and vaccines. It is recommended to ensure that players are vaccinated for hepatitis B. Simple strategies for reducing the spread of infectious diseases are highly effective, such as hand washing, bleeding wounds management—and blood in general, having a common policy for infections.

42.3 Main Pathologies in Athletes

42.3.1 Upper Respiratory Tract Infections (URTIs)

There is an increased risk of URTI when intense training is prolonged or during competition. Symptoms may last between 3 and 14 days in 30–40% of consultations and researchers claim that there are fewer URTI immune alterations in team sports than in endurance exercise like marathon running, triathlon, or swimming.

URTI is caused by infectious pathogens: rhinoviruses, coronaviruses, respiratory syncytial virus, influenza, para-influenza, and adenoviruses. Non-specific symptoms of the upper airways in viral infections include coughing, sneezing, congestion, sore throat, mucus production, and bronchoconstriction.

Although complications such as bacterial infections or infections affecting the lower respiratory tract can appear. In general, they are self-limited syndromes but special attention should be given to athletes suffering from asthmatic conditions.

Transmission occurs through droplets and close contact with infected patients. Swimmers and other water sports athletes may be predisposed to sinusitis, pharyngitis, otitis, and conjunctivitis. *Acute sinusitis* is generally caused by viral infection, and is frequently resolved within 7–10 days. Bacterial sinusitis might last up to 30 days—without treatment in 75% of the cases. *Influenza infections* are acute respiratory diseases whose main symptoms are malaise, myalgia, headache, cough, sore throat, and high fever. It presents a sudden onset and an incubation period of 1–5 days, lasting about 8–10 days. Possible complications include secondary bacterial infections, *pneumonia*, *otitis media*, *meningitis*, *encephalitis*, *myocarditis*, *myositis*, *rhabdomyolysis*, and *Guillain–Barré syndrome*, among others. Prevention includes keeping symptomatic athletes away from training rooms and competition during recovery.

Infectious mononucleosis, “the kissing disease,” is caused by Epstein–Bar virus and is accompanied by lymphadenopathy, tonsillar pharyngitis, and fever.

Although frequently undiagnosed splenomegaly can be detected in around 50% of cases and there is the risk of splenic rupture. Close medical study includes spleen ultrasound imaging and treatment usually includes NSAIDs. In the presence of pharyngeal bacterial super-infection, additional antibiotic treatment could be necessary; however, penicillin or ampicillin should be avoided due to probable severe skin reactions (Fig. 42.2).

Depending on the severity of the activity and the symptomatology of URTI, athletes should abstain from intensive physical exercise since it could affect their immune system negatively.

42.3.2 Skin Infections in Athletes

Most sports involve close physical contact, especially wrestling and rugby, but also football, basketball, and many others (Fig. 42.3). This allows infections to be passed from skin to skin or through floors, mats, shared towels, or communal use of equipment such as callus cutters or soc-

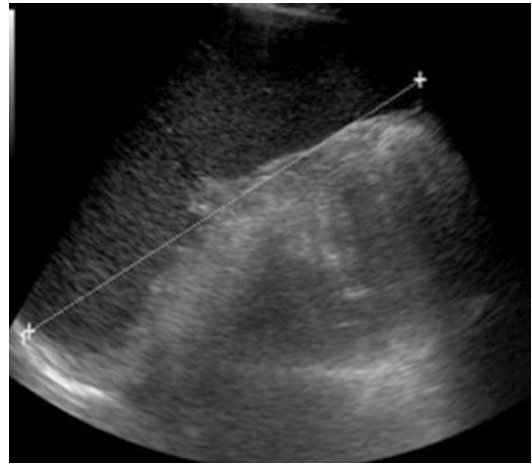


Fig. 42.2 Ultrasound—splenomegaly in a patient affected by infectious mononucleosis



Fig. 42.3 Risk of transmission through direct contact in wrestlers

cer shin guards. The main measures of infection control in this case should include hand washing, proper and regular cleaning of facilities, and preventing shared use of personal items.

Etiology can be viral: Herpes simplex virus (HSV) infection, *Molluscum contagiosum*, and Warts. HSV is the most common skin infection affecting especially wrestlers, *Herpes gladiatorum*,

and rugby players *Herpes rugbiorum*. Transmission occurs through contact, 20 and 40% of wrestler athletes are infected with HSV.

Skiers could present recurrent herpes labial infection due to exposure to low temperatures and ultraviolet solar radiation.

HSV infection incubation period ranges between 5 and 10 days and the symptoms include fever, malaise, and painful oral or genital lesions, although lesions are common on the head and face—areas of frequent contact.

Community-acquired methicillin-resistant *Staphylococcus aureus*, **MRSA**, is one of the major **bacterial skin infections** among athletes, together with **streptococcal skin infections**. Identifying and treating lesions is not only important for the individual affected but also for limiting possible transmission (Figs. 42.4 and 42.5).



Fig. 42.4 Scrum pox



Fig. 42.5 Tinea pedis

Other frequent infection among athletes with contact sports is **Dermatophytosis**. It appears in different parts of the body: head, neck, trunk, and extremities and presents circular, scaly, red, itchy skin lesions, usually with an active border.

Fungal skin infections common for athletes include: *Tinea corporis*—Ringworm, *Tinea pedis*—athlete's foot, and *Tinea cruris*—jock itch. The most prevalent fungal skin infections are: *Malassezia furfur*: 50%, *Trichophyton tonsurans*: 30%, and *Epidermophyton floccosum* 7.5%.

Regular skin checks are necessary in the case of wrestlers in order to rule out herpes, impetigo, and ringworm so that they can be treated before tournaments. Prophylactic measures include medications to prevent herpes recurrences.

42.3.3 Blood-Borne Infectious Diseases in Athletes

Several blood-borne infectious diseases—among them viral hepatitis B and C, and human immunodeficiency virus (HIV) infection—may be transmitted by body contact during sports activities. In professional football, for example, there are—on average—four bleeding injuries per game. However, researchers consider that the estimated risk of HIV transmission seems to be less than one in one million. In the case of hepatitis B transmission during exercise, the theoretical risk is also extremely low—a bit above the risk of HIV transmission.

There are seven known hepatitis viruses (A, B, C, D, E, F, and G), of which hepatitis A and E are usually passed from person to person, whereas hepatitis B, C, and G viruses are transmitted by blood. Wrestlers and boxers are in close body contact, then they are more prone to infections than soccer and basketball players or judo athletes, whose risk of blood-borne pathogen transmission is moderate. These pathogens could be transmitted by the use of common contaminated items or bleeding wounds during sports. Health care professionals should pay careful attention to the risk of horizontal transmission of hepatitis B in contact sports.

It is the responsibility of athletes to inform physicians, trainers, and other staff about any health condition as well as possible injuries or lesions before competition. If there is bleeding during competition, the athlete should be removed from play immediately, bleeding should be controlled, the wound should be washed with soap and water, or an antiseptic solution, and the area should be covered with occlusive dressing to resist the impact of sport activity. Once the situation has been brought under control, the player can return to play. Players with blood stained garments should change before returning to play. In the case of scratches or mild non-bleeding wounds, the play should not be stopped and the wound can be covered during the break.

42.4 Diagnosis and Treatment

The importance of early diagnosis and appropriate clinical management in the treatment of an infected athlete should be emphasized. Proper diagnosis will ensure minimum risk of transmission, reduced time loss from competition, and prevention of large outbreaks. Initial clinical assessment, together with disease history-taking should be conducted so as to confirm the infectious disease and determine—if possible—the infectious agent. This includes examination of lungs, throat, lymph nodes, and abdomen palpation. The laboratory blood screening should include blood cell count, liver enzymes, and C-reactive protein, in order to determine inflammatory parameters and possible organic involvement.

In the case of elite athletes, resting ECG recording and US imaging are necessary so as to determine the absence of pathological changes that may indicate myocarditis or pericarditis. Few URTI patients require specific treatment; they generally show gradual recovery after symptomatic treatment with nonsteroidal anti-inflammatory drugs (NSAIDs), which allows prompt return to training and competition. General principles of treatment are described in Table 42.1.

Table 42.1 General principles of treatment

Treatment principles in specific infections	
<i>Upper respiratory tract infections (URTIs)</i>	Symptomatic treatment NSAIDs
Sinusitis	Anti-histamines ± NSAIDs
Acute otitis media	Amoxicillin ± clavulanate
Acute bronchitis	NSAIDs + bronchodilators
External otitis	
Conjunctivitis	Quinolones, gatifloxacin, levofloxacin, or moxifloxacin Vasoconstrictive eye drops
Pneumonia	Macrolides, azithromycin, clarithromycin
<i>Viral skin lesions</i>	
HSV	Acyclovir, 400 mg three times/ day for 7–10 days
Herpes gladiatorum	Valacyclovir
<i>Fungal skin lesions</i>	Clotrimazole, ketoconazole Burow's solution, aluminum chloride can be used for drying the lesions Griseofulvin, terbinafine, itraconazole

42.5 Prevention

Universal precautions based on common sense decisions are fundamental when trying to prevent infections in athletes. First of all, vaccines, such as HBV, are recommended in all cases, and HAV vaccination for those who need to travel to endemic regions. Also, athletes that show any signs or symptoms—such as rashes or other—should be observed. Regarding MRSA and GABHS prevention, it should focus mainly on proper hygiene practices like limiting exposure to contaminated items or infected persons, avoiding the use of shared equipment or water bottles and removing contaminants from the environment. Finally, prompt diagnosis, adequate treatment, and close follow-up of infected patients will further ensure prevention.

Besides, wrestlers and rugby players should be examined for lesions—vesicular or ulcerative—on parts of their bodies that could be in touch with other athletes and around their mouths or eyes every time they train or compete. The physician in charge should be knowledgeable about muco-cutaneous infections like HSV, impetigo,

and herpes zoster. Athletes having these types of lesions will be excluded from competition until all lesions are dry and crusted.

42.6 Return to Play After Acute Infectious Disease

Sports physicians are expected to assess eligibility for return to play after infectious diseases on the bases of individual observation of every particular case since there are no general guidelines. The decision should result ideally from joint agreement between the physician, the coach, and the player.

After symptoms have disappeared the athlete can return to training, ensuring physical examination is normal, blood values for inflammation parameters correct, and resting/exercise ECGs have been performed.

Before returning to competition, athletes should return to training and increase exercise intensity day to day on an individual basis. If well tolerated, in most cases, return to competition happens within a time period ranging from 3–5 days to 2–3 weeks.

42.7 Pitfalls for Athletes and Sports Physicians

Athletes should develop their activities in optimal conditions, trying to avoid stress, periodizing training to avoid prolonged overreaching and overtraining, trying to get regular sleep, eating well, and prevent rapid weight loss, to have yearly influenza vaccination, to avoiding crowds and contact with sick people prior to major competitions, washing their hands before all meals, and following training. In the case of skin infection, limiting physical contact may be enough. Athletes suffering from a respiratory or gastrointestinal infection should be removed from the team environment. Ideally, they would have their own room and not eat with the team.

For physicians, the use of universal preventive measures, like gloves, is important. This is especially true with regard to blood-borne diseases. All blood should be treated as if it was contaminated. Covering wounds and cleaning bloody surfaces are essential.

42.8 Fact Box

- Infectious diseases can be prolonged or aggravated by continuing physical activity and athletes also risk having other acute or chronic complications.
- The main measures of infection control to prevent skin infections disease should include hand washing, proper and regular cleaning of facilities, and preventing shared use of personal items.
- Early diagnosis will ensure minimum risk of transmission, reduced time loss from competition, and prevention of large outbreaks.
- Return-to-play decisions after acute infectious diseases have to include a final medical check-up.

Recommended References

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