

Fighting Fit

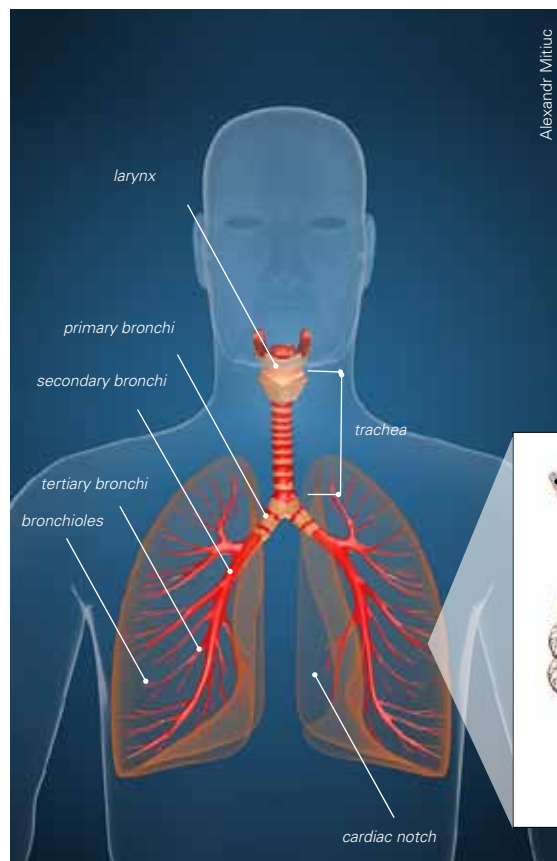
How exercise affects your immunity and susceptibility to infection

We all suffer from colds at some time but recent research indicates that a person's level of physical activity influences their risk of respiratory tract infections such as a cold, most probably by affecting immune function. Moderate levels of regular exercise seem to reduce our susceptibility to illness compared with an inactive lifestyle but long hard bouts of exercise and periods of intensified training put athletes at increased risk of colds and flu.

Immune function and infection risk

Infections of the nose, throat, windpipe (trachea) or the two airways that branch from the trachea as it reaches the lungs (bronchi) are the most common infections that people get.

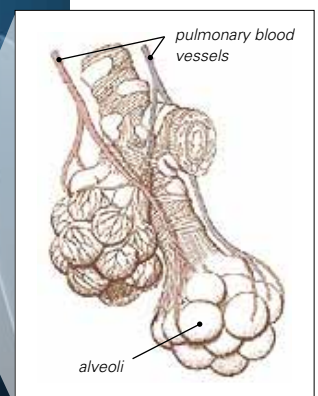
These upper respiratory tract infections (URTIs) include the common cold, sinusitis and tonsillitis, and most are due to an infection with a virus. The average adult has two to three URTIs each year and young children have twice as many. We are constantly exposed to the viruses that cause these infections, but some people seem more susceptible to catching URTIs than others.



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Key words

immune system
pathogens
hormones
exercise



Every day, our immune system protects us from an army of pathogenic microbes that bombard the body. Immune function is influenced by an individual's genetic make-up as well other external factors such as stress, poor nutrition, lack of sleep, the normal aging process, lack of exercise or overtraining. These factors can suppress the immune system, making a person more vulnerable to infection.

Exercise and the immune system

Exercise can have both positive and negative effects on the functioning of the immune system and can influence a person's vulnerability to infection. Researchers have found a link between moderate regular exercise and reduced frequency of URTIs compared with an inactive state and also between excessive amounts of exercise and an increased risk of URTIs. A one year study of over 500 adults found that participating in 1-2 hours of moderate exercise per day was associated with a one third reduction in the risk of getting a URTI compared with individuals that had an inactive lifestyle.

Other studies have shown that when forty minutes of moderate exercise is repeated on a daily basis there is a cumulative effect that leads to a long-term improvement in immune response.

This research showed that people who exercise 2 or more days a week have half as many days off school or work due to colds or flu as those who don't exercise. Other factors that were correlated with a reduction in infection risk included a high intake of fruit, being married, being male, having a moderate or high level of fitness and having a low level of mental stress.

However, more is not always better in terms of exercise volume as other studies have reported a 2- to 6-fold increase in risk in developing an URTI in the weeks following marathon (42.2 km) and ultra-marathon (90 km) races. This is due, in part, to increased levels of stress hormones like adrenaline and cortisol (see box below) that suppress white blood cell functions. After strenuous exercise, athletes enter a brief period of time in which they experience weakened immune resistance and are more susceptible to viral and bacterial infections, in particular URTIs.

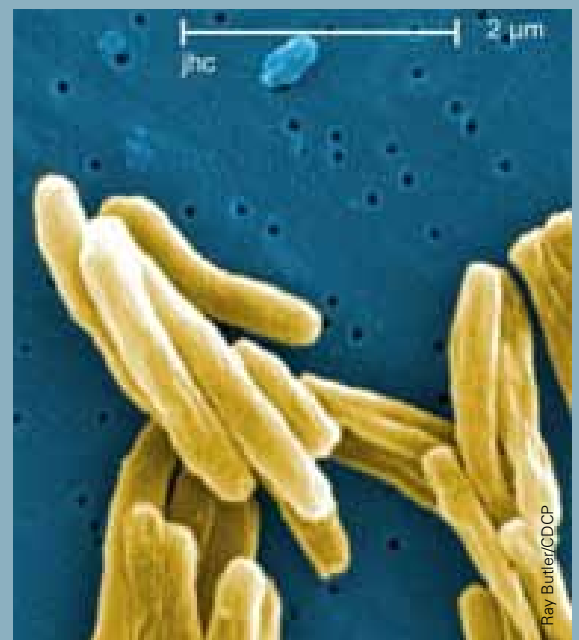
Another problem for athletes is that their exposure to pathogenic (disease-causing) microorganisms in the environment may be higher than normal due to increased rate and depth of breathing during exercise (increasing exposure of the lungs to airborne pathogens), exposure to large crowds and frequent foreign travel.

Pathogens

A pathogen is an agent causing disease or illness to its host, such as an organism or infectious particle capable of producing a disease in another organism. Pathogens are mostly microscopic, such as bacteria, viruses, protozoa, and fungi, thriving in various places such as air, dust, dirty surfaces, soil, etc. Not all bacteria are pathogens; in fact, most of them are harmless and only a few are pathogenic. Examples of pathogenic bacteria are *Mycobacterium tuberculosis* (causing tuberculosis), *Streptococcus pneumoniae* (causing pneumonia) and *Salmonella* (causing food-borne illnesses). Examples of diseases caused by pathogenic viruses are smallpox, influenza, mumps, measles, chickenpox and rubella. The common cold is also usually caused by a viral infection.



Sneezing - one way that viruses are spread from person to person.

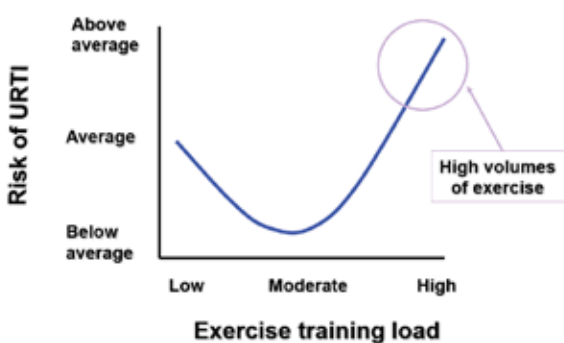


Mycobacterium tuberculosis, the bacterium that causes tuberculosis.



Causes of increased infection in athletes

Some of the reported sore throats may not be due to infectious agents but to non-infectious airway inflammation caused by allergies or inhalation of pollutants. A 'J'-shaped model has been used to describe the relationship between the amount of physical activity that is undertaken and risk of URTI.



The 'J-shaped' model of exercise and upper respiratory tract infection (URTI) risk

This increased sensitivity to infection with high exercise may be due to a depression in immune system function of the individual. Studies have shown that prolonged strenuous bouts of exercise cause a temporary suppression of various immune cell functions and that performing such exercise on a regular basis with limited recovery can result in a longer lasting and more severe depression of immunity.

These studies involve the collection of blood samples from volunteers before and after prolonged exercise. The blood can be analysed using automated cell counters to measure the numbers of the total white blood cells and the various subsets (e.g., neutrophils, monocytes and lymphocytes). A machine called a flow cytometer can be used to count numbers of the different lymphocyte types (e.g., natural killer cells, B cells and T cells) and can also be used to measure certain white blood cell functions.

Most people are more susceptible to colds in winter but numerous studies on athletes indicate that they tend to be most susceptible to picking up infections at times close to competition. This usually follows a period of intensive training and added mental stress with the anxiety of wanting

to perform well. The worry for athletes is that even a mild infection can impair their ability to perform at the highest level. Preventing infections is therefore very important to them and they can help themselves by ensuring good personal hygiene, good nutrition and minimizing other life stresses.



Fit today, flu tomorrow?

The message from research

The message from current research is that moderate exercise has a positive effect on the immune system. So to keep colds at bay we should all go out for a brisk walk or participate in sports at least several times per week. Being active on a regular basis also comes with other health benefits including a reduced risk of developing metabolic diseases (e.g. type 2 diabetes) and cardiovascular diseases (e.g. coronary heart disease) later in life. The higher infection risk that comes with very high (some might say excessive) levels of exercise is the small price that athletes pay for being a potential Olympic gold medallist.

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Hormones, exercise and immune function

Adrenaline, often known as the 'flight or fight' hormone, is produced by the adrenal glands in response to physical activity. It is constantly produced in small amounts to maintain normal blood pressure. During exercise, larger amounts of the hormone are released into the bloodstream where it prepares the body for increased physical activity by speeding up the heart rate, diverting blood flow to the muscles, widening the airways, dilating the pupils and raising the blood sugar level. However, adrenaline can also suppress some immune cell functions.

Corticosteroids are hormones produced by the inner part of the adrenal glands (called the adrenal cortex) and have a wide range of physiological functions. They include glucocorticoids – the most important of which in humans is cortisol. Cortisol is known as a stress hormone as it is secreted at higher levels in response to stressful situations. Elite athletes are exposed to the psychological stress of competition (worry/anxiety). During endurance events and over-training, the body is exposed to the physiological stress of prolonged exercise, and performing exercise in extreme environments – heat, cold and altitude – can put additional stress on the body. Elevated secretion of glucocorticoids in these situations suppresses the immune system.