

# The effects of smoking on the

According to the World Health Organization (WHO), tobacco is one of the biggest public health threats the world has ever faced. In 2006 and 2007 bans were introduced across the UK to make it illegal to smoke in all enclosed work and public places. **Mark Thompson** explains

No matter how you smoke it, tobacco is dangerous to your health. There are no safe substances in any tobacco products, from acetone and tar to nicotine and carbon monoxide. The substances you inhale don't just affect your lungs. They can affect your entire body.

Pietrangelo, A. and Cherney, K. (2017) [www.healthline.com/health/smoking/effects-on-body#1](http://www.healthline.com/health/smoking/effects-on-body#1)

In 2008, the WHO introduced further measures to combat smoking globally, using the acronym MPOWER, which aimed to:

- Monitor tobacco use and prevention policies
- Protect people from tobacco use
- Offer help to quit tobacco use
- Warn about the dangers of tobacco

- Enforce bans on tobacco advertising, promotion and sponsorship
- Raise taxes on tobacco

## Why is smoking dangerous?

The American Lung Association suggests that cigarettes contain around 600 ingredients and when burned they release over 7,000 chemicals. Smoking is linked to an increased risk of certain cancers and cardiovascular disease. The most common diseases caused by smoking are lung cancer and chronic obstructive pulmonary disease (COPD) (Milner 2004). The US Centers for Disease Control and Prevention

A healthy lung (left) compared with a lung damaged by smoking (right)



# respiratory system

identified smoking as the most common preventable cause of death in the USA (Pietrangelo and Cherney 2017). The nicotine in tobacco is addictive and, as a drug, comes under the category of a legal stimulant, like caffeine. This means it increases the activity of the central nervous system and the body.

Box 1 shows a list of issues identified as relating to smoking. The list is extensive and damaging to a range of areas and body systems, including the respiratory and nervous systems, which are critically important to maintaining good health and the ability to maintain a high level of physical fitness and skill.

## The respiratory system

The respiratory system is a series of organs, the main functions of which are taking in oxygen and expelling carbon dioxide, through the mechanics of inhalation and exhalation (or more simply, breathing). The components

of the respiratory system include the mouth and nasal cavity, trachea (windpipe), bronchus, bronchi, bronchioles, alveoli and the lungs.

Within the mechanics of breathing, muscles such as the diaphragm and intercostals are utilised. It is a vital system for keeping us alive and provides other organs like the brain with oxygen. Furthermore, it is vital to maintaining health and fitness and provides our muscles with oxygen to respire aerobically and meet the general demands of life and exercise.

As with most systems in the human body, the respiratory system needs to be maintained by a healthy lifestyle to keep it efficient and functioning optimally. It can also adapt and be improved through exercise, and is negatively affected by unhealthy lifestyle choices and disease.

## Smoking and respiratory health

Smoking has a direct effect on the respiratory system (Tantisuwat and Thaveeratitham 2014) and many detrimental effects on our respiratory health. Milner (2004) identified damage throughout the respiratory 'tree' in the bronchus, bronchioles and the alveoli. She also identified loss of cilia (found in the trachea and responsible for sweeping mucus and dirt out of the lungs), mucous gland hypertrophy, inflammation and congestion in the airways and the destruction of alveoli. She identified vascular changes to the capillaries surrounding the bronchioles and alveoli, affecting the rate of gaseous exchange. Blood vessels can constrict, restricting blood flow and increasing blood pressure (Pietrangelo and Cherney 2017).

Cigarette smoking has been found to be a cause of asthma. Asthma is a common inflammatory disease of the airways of the lungs (trachea, bronchus, bronchi and bronchioles) that causes



airflow obstruction. The symptoms of asthma include wheezing, coughing, chest tightness and shortness of breath. Symptoms can temporarily get worse, leading to an asthma attack. It is usually treated with inhalers (see Further reading).

Long-term smoking reduces expiratory reserve volume and vital capacity (Middleton 2004). This means that our lungs become less efficient and cannot cope with the demands of aerobic exercise as effectively, ultimately limiting performance where endurance is required.

## Effects on exercise performance

With the vast and varied negative effects already identified, exercise performance is affected by smoking in many ways. Hobbs (2017) states that smoking can impair physical fitness long before the chronic diseases arise, and that even limited or occasional use can affect athletic performance. Aerobic endurance is particularly affected, as the majority of issues caused involve oxygen consumption and carbon dioxide removal.

## Airflow

The inflammation and congestion in the airways affects the flow of air into and out of the lungs. This obstruction affects the amount of oxygen that can be inhaled and the amount of carbon dioxide that can be exhaled. This will directly affect cardiovascular

## Box 1

### Issues related to smoking

- COPD (chronic obstructive pulmonary disease)
- Lung cancer
- Pneumonia
- Anxiety and irritability (due to the stimulant effect of nicotine and subsequent withdrawal)
- Bronchitis (inflammation of the bronchi)
- Persistent coughing
- High cholesterol
- Increased blood pressure (hypertension)
- Infertility
- Erectile dysfunction
- Blood clotting
- Smoking-induced asthma
- Diabetes
- Loss of appetite
- Poor vision (increased risk of glaucoma, cataracts, macular degeneration)
- Dull sense of smell and taste



endurance and reduce  $VO_2$  max (the maximum amount of oxygen an individual can get into the body and utilise per minute). Destruction of alveoli and the capillaries surrounding them will also lead to similar negative effects. The alveoli are where gaseous exchange takes place between the lungs and the bloodstream, specifically the capillaries, and where the respiratory and circulatory system meet in the cardiovascular system.

### Gas exchange

With fewer alveoli, gaseous exchange rate is slower due to a loss of gaseous exchange surface area, once again negatively affecting  $VO_2$  max and cardiovascular endurance. Blood vessel constriction affects the flow of blood through the blood vessels (capillaries, veins and arteries). This means the blood flows slower, which affects the speed at which oxygen reaches the working muscles and carbon dioxide reaches the lungs. This in turn affects the rate of energy production and ATP resynthesis in the aerobic system.

Lactate threshold will be lower due to the lack of oxygen able to be supplied to working muscles. Removal of lactic acid will also take longer, prolonging recovery rates. This will have a clear effect on cardiovascular and muscular endurance, meaning an individual finds it harder to maintain higher intensity exercise for very long. Fatigue (extreme tiredness) will kick in faster due to the increased lactic acid in the muscles.

### Elasticity and muscles

Hobbs (2017) identified a loss of lung elasticity and capacity due to inflammation and degradation of elastic tissue. Severe loss is referred to medically as emphysema but a decrease can occur long before the presentation of emphysema symptoms. The decrease in lung capacity will cause a shortage of breath at lower effort levels, inhibiting performance intensity and the ability to sustain exercise.

Although stating that more research is warranted, in a test of former smokers

## Box 2

### Somatic effects of smoking

- Shaking
- Sweating
- Irritability
- Butterflies in the stomach
- Heavy breathing
- Elevated heart rate

## Box 3

### Cognitive effects of smoking

- Negative thoughts regarding performance
- Fear of failure
- Feelings of apprehension and nervousness

and non-smokers, Formiga, Campos and Cahalin (2018) suggested that smoking also has potentially deteriorating effects on the respiratory muscles (internal and external intercostal muscles). These are the key muscles that aid the function of inhalation and exhalation.

### Summary of effects

In a sport-specific setting, poor vision can affect performance, with it being an important sense in most sports. In addition, anxiety and irritability (caused by the stimulant effect of nicotine) can cause negative effects both physically (somatic, see Box 2) and mentally (cognitive, see Box 3). These include:

- inflammation and congestion of airways, preventing efficient airflow
- destruction of alveoli (the site of gaseous exchange in the lungs)
- vascular changes in capillaries (the blood vessels where gaseous exchange takes place)
- blood vessel constriction, causing a slower flow of blood around the body (oxygen transport to the muscles and  $CO_2$  removal)
- weakened respiratory muscles and lung elasticity
- asthma — a respiratory disease with symptoms that can affect exercise

performance (particularly aerobic activities)

- reduced exercise tolerance, including general shortness of breath during exercise, limiting performance levels
- prolonged recovery time (excess post-exercise oxygen consumption, EPOC — see page 24).

Research findings from Tantisuwat and Thaveeratithain (2014) highlighted the negative effects on the respiratory system of cigarette smoking in youths and concluded that their results should be used to encourage young people to quit or avoid cigarettes. The inhalation of smoke clearly has many negative effects on health in general and on exercise performance. Smoking cessation has been confirmed by research to prevent further deterioration of lung function and result in improvement in the inflammation of the airways (Middleton 2004). However, some effects are not fully reversible and experts suggest that smoking should therefore be avoided, first and foremost for health reasons but also to maintain fitness and exercise performance.

### Further reading



Formiga, M. F. et al. (2018) 'Inspiratory muscle performance of former smokers and non-smokers using the test of incremental respiratory endurance', *Respiratory Care*, 63(1), 86–91.

Hobbs, J. (2017) 'How does smoking affect sport performance?' Live Strong, [www.tinyurl.com/ycltrr78](http://www.tinyurl.com/ycltrr78)

Milner, D. (2004) 'The physiological effects of smoking on the respiratory system', *Nursing Times*, Vol. 100, No. 24, p.56.

Tantisuwat, A. and Thaveeratitham, P. (2014) 'Effects of smoking on chest expansion, lung function, and respiratory muscle strength of youths', *Journal of Physical Therapy Science*, 26(2), 167–170.

To find out more about asthma and its treatment:

[www.nhs.uk/conditions/asthma](http://www.nhs.uk/conditions/asthma)

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