

Smoking and Chronic Obstructive Pulmonary Disease (COPD)

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Key points:

- Chronic Obstructive Pulmonary Disease (COPD) refers to a variety of conditions which cause narrowing (obstruction) of the airways.
- The main symptoms are, increasing breathlessness, a persistent chesty cough with phlegm, frequent chest infections and persistent wheezing.
- The vast majority of COPD cases is caused by smoking.
- Most COPD cases develop through inflammation in the lungs caused by exposure to tobacco smoke.
- As a smoking-related disease, COPD is closely linked to inequalities and has increased prevalence in deprived areas.
- Second-hand smoke (SHS) may have a role in causing or worsening COPD.
- The best way for smokers with COPD to improve their health is to quit smoking.
- Around 2% of the population in Scotland has COPD, causing the fourth greatest burden to the NHS

Background

COPD is the umbrella term for a variety of chronic illnesses affecting the lungs and airways, causing “airflow limitation that is not fully reversible”.¹ It includes chronic bronchitis, where airways are inflamed in the long-term, and emphysema, where the alveoli in the lungs are permanently damaged. This leads to obstruction of the airways and consequently difficulty in breathing. COPD is diagnosed using a test of the amount of air a patient can breathe out over a period of time known as spirometry.^{1,2}

The symptoms of COPD are generally linked to this breathing difficulty. Breathlessness after little or no exertion is common and can have a severe impact on the quality of life. Symptoms can worsen dramatically (exacerbate) and gradually or suddenly, which can be caused by environmental factors, infections,³ or occur without a clear reason.⁴ Exacerbations generally become more common over the course of the disease.⁵

Most people with COPD have at least one other chronic condition at the same time, such as diabetes, heart disease, and hypertension (high blood pressure). It is unclear if, or how much, these comorbid conditions are caused by COPD itself, by smoking⁶ (which is known to negatively influence most diseases), or by chance. Many common comorbidities, such as lung cancer and cardiovascular illness can be life-limiting. As such, around two-thirds of deaths in COPD patients occur due to comorbidities, while respiratory failure due to airway obstruction only becomes predominant in advanced COPD.⁷ Much of the harm caused by COPD is in the form of disability and the impairment of quality of life, which gradually and progressively declines. Smoking can significantly accelerate the disease progression of COPD.

As a chronic illness, there is no cure for COPD. A wide variety of drugs, such as corticosteroids, are available to treat symptoms,⁸ while medical oxygen is often prescribed for those with advanced COPD who have severe breathing difficulties.⁹

COPD is a common condition, with a global prevalence of around 12.2%, of which 15% in men and 9.9% in women.¹⁰ The condition is estimated to cause more than 3 million deaths worldwide annually¹¹ and expected to be one of the top four causes for death by 2030.^{2,12} It has been estimated that 1.2 million people in the UK have COPD, representing 2% of the total population.¹³ The disease occurs nearly exclusively in those over forty, and is commonly underdiagnosed.¹⁴

COPD in Scotland

COPD prevalence in Scotland has been estimated at just over 2%, costing the healthcare system around £159 million per year in 2011.¹⁵ Counter to expectations, data between 2010 and 2019 has shown that COPD prevalence has not drastically changed.^{15,16} Although this is positive news, it suggests that the cost to healthcare system remains in line with that last calculated in 2011. A 2015 report by NHS Health Scotland suggested that COPD caused the fourth greatest burden of disease of a range of conditions, following heart disease, neck and lower back pain, and depression.¹⁷

The Scottish Government's tobacco strategy, *Creating a Tobacco-Free Generation*,¹⁸ details a range of steps to reduce smoking prevalence and thereby COPD incidence.

Association with Smoking

Cigarette smoking is by far the dominant cause of COPD. Ten to 20% of smokers will go on to develop the illness, but just 10% of total cases occur in non-smokers.¹⁹ With that in

mind, strategies to prevent COPD must deal, first and foremost, with reducing smoking rates.

Cigarette smoke damages the interior of the lung, causing injury to the airways and the alveoli. Over time, these injuries can progress into COPD. Smoking may also contribute to a greater likelihood of respiratory infections in those with COPD²⁰ – a causative factor in exacerbations.

Other factors related to COPD incidence include genetic disorders such as alpha-1 antitrypsin deficiency, and asthma diagnosis, exposure to outdoor air pollution and exposure to second-hand smoke, although it is not always possible to identify these as causative factors.²¹

How COPD Develops

The development of emphysema is thought to follow a set pattern. Exposure to cigarette smoke (or another pollutant) causes immune cells to build up within the alveoli in an attempt to combat a perceived pathogen. These cells begin an inflammatory response which damages tissue and kills structural cells in the lungs. When the body repairs itself, it does so imperfectly leading to enlargement of the airways, making them less efficient.²²

It has been suggested that lower lung function and injury during childhood may predispose individuals to develop COPD. Maternal smoking and leads to reduced lung function in the offspring and has been shown to lead to significantly increased odds of getting COPD in later life. Smoking by the father in the first 5 years of life is also associated with increased risks.²³

Alpha-1 antitrypsin deficiency

About 1-2% of those with COPD have severe alpha-1 antitrypsin deficiency.²² This genetic disorder leads to low levels of the enzyme (alpha-1 antitrypsin), which usually protects cells from harmful inflammatory effects. Without this enzyme, tissues in the lung are broken down and inflamed, causing bronchitis. Sufferers who smoke are considerably more likely to develop COPD than either non-smoking sufferers or smokers without the deficiency.

Inequalities

As COPD incidence is closely related to smoking, and in developed countries, smoking is linked to deprivation, it follows that COPD is a disease of poverty in Scotland and the UK.

The association between deprivation and COPD incidence is very clear, with around four times as many hospital admissions due to COPD among the most deprived fifth of Scots as compared to the least deprived fifth.⁴⁹

Comorbidities

The majority of people with COPD have at least one co-existing chronic condition.^{24,25} These illnesses can have the same direct cause as COPD, such as lung cancer caused by smoking, or they can co-exist due to environmental factors and health inequalities, such as obesity. While around one-third of COPD patients die because of that condition directly, two-thirds die due to comorbidities, particularly cardiovascular illness and lung cancer.⁷

It has been suggested that, rather than regarding comorbidities as a series of separate illnesses affecting different organs, many conditions can be seen as manifestations of the same reactive inflammation to smoking which often causes COPD.²⁶ This could apply to conditions such as cardiovascular disease, bronchiectasis and osteoporosis.

Cardiovascular diseases

Illnesses of the heart and circulatory systems, including cardiovascular disease, ischaemic heart disease, hypertension and heart failure, are closely linked to COPD. This may be caused in part by the systemic inflammation observed in COPD.²⁷

For those with mild or moderate COPD, cardiovascular illness is a more common cause of death than respiratory failure.⁷

Lung Cancer

As smoking is by far the primary cause of both lung cancer and COPD, many COPD patients will also have a significantly increased risk to develop lung cancer. Lung cancer is a more common cause of death in mild to moderate COPD than respiratory failure.⁷

The mechanism by which smoking causes lung cancer and COPD may be linked in some cases, with injury to the lung resulting in mutation and the later development of cancer as well as the inflammatory response which precedes COPD.²⁸ Lung cancer and COPD are linked even when controlling for smoking status.²⁹

Other respiratory conditions

Bronchiectasis, a permanent widening and scarring of the airways, is closely related to COPD and is common in smokers with moderate to severe forms of the condition.^{30,31} Those with both conditions have a greater risk of death³² and face longer hospital stays than patients with only COPD.³³

Mental Health

Depression and anxiety disorders are common among COPD patients, with as many as 20-60% suffering.³⁴ This may be linked to the experience of physical distress, as the discomfort and pain of the disease causes anxiety and mental anguish.³⁵

Osteoporosis

Osteoporosis is characterised by lowered bone density, and changes in bone structure lead to an increased risk of fracture. The condition is common in COPD patients, and smoking is a known risk factor.³⁶ The prevalence of osteoporosis among COPD patients is 38%, although some study estimates are as high as 69%, but is generally significantly higher than in the general population, although the risk for osteoporosis in those with obesity and COPD is likely to be much higher than non-obese COPD patients.^{37,38}

The condition is essentially asymptomatic until a fracture occurs, but after that can have understandably severe effects on mobility - a serious concern, since around 56% of COPD patients have some form of reduced mobility.³⁹ Smoking cessation is a recognised and widely recommended treatment for sufferers.³⁷

Obesity and malnutrition

Counterintuitively, both obesity^{40,41} and low body weight^{42,43} are significantly more common in COPD patients than in the general population.

Low body weight and malnutrition are associated with higher risk of hospital admission and mortality. Many people with COPD do not feel able to eat properly, due to a range of symptoms, including loss of appetite, dyspepsia, diarrhoea and breathlessness before eating.⁴⁴ Consequently, it can be difficult to gain enough energy from food to prevent weight loss. High-calorie diets and supplementation are often prescribed in these circumstances.⁴⁵

People with COPD expend more energy at rest than those without the condition,⁴⁶ possibly due to the greater effort required to breathe with stiff lungs and obstructed airways.⁴⁵ This could contribute to lower body weight.

Possibly for these reasons, obese patients with severe COPD have been observed to have higher survival and lower hospitalisation rates than healthy weight or underweight individuals.⁴³ It is unlikely that having COPD increases the odds of weight gain. However, in countries where both smoking and obesity are most prevalent among the poorest people, it follows that this demographic will have higher rates of the two combined.

Second-hand smoke

Second-hand smoke (SHS) exposure is associated with COPD, although on its own, without other risk factors, it is unlikely to play a causal role.²¹ Several studies have linked cumulative exposure to the odds of having the condition. Exposure to SHS can lead to a rapid decline in spirometry and inflammation of the airway,⁴⁷ factors related to COPD. Exposure to SHS is linked to exacerbation and hospitalisation.⁴⁸

Interventions to improve health

The single best way for an individual who smokes to reduce the impact of COPD on their life is to quit smoking. Many people with COPD continue to smoke – around 37% across the UK in 2005, according to a 2010 survey-based study.⁵¹ Quitting smoking slows the rate of lung function decline, disease progression and risk of respiratory infections.

Many studies have looked at the effectiveness of cessation interventions in this population. In general, a combination of pharmacological (including nicotine replacement therapy as well as drugs such as varenicline) and behavioural support has been found to be effective to help patients stop smoking.⁵² Stop-smoking interventions are highly cost-effective - less than half the cost of even the cheapest COPD drug treatment.⁵³ Whatever method of cessation is chosen, seeking professional cessation support significantly increases chances of a successful quit. In Scotland, free support is available from the NHS Quit Your Way services. <https://www.nhsinform.scot/quit-your-way-scotland>

Pulmonary rehabilitation, a form of exercise and education programme intended to improve the symptoms of COPD, is a common and well-evidenced treatment.⁵⁴ A wide variety of patients can benefit from rehabilitation, regardless of the disease severity or smoking status.⁵⁵ Stop smoking advice and help can be given during sessions.

Long-term oxygen therapy (LTOT) is widely prescribed and used and leads to lower mortality for patients with very low levels of blood oxygen (though it may not be effective for those with milder forms of hypoxemia).⁹ Due to the serious risk of fire posed by concentrated oxygen, this treatment may not be suitable for patients who continue to smoke.

Further Information

The British Lung Foundation provides general information and advice about COPD on its website (<https://www.blf.org.uk/support-for-you/copd/what-is-copd>)

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