

Nicotine and addiction

What does the term addiction mean?

Addiction is defined by the World Health Organization as “repeated use of a psychoactive substance or substances, to the extent that the user is:

- periodically or chronically intoxicated,
- shows a compulsion to take the preferred substance(s),
- has great difficulty in voluntarily ceasing or modifying substance use,
- exhibits determination to obtain psychoactive substances by almost any means, and
- tolerance is prominent and a withdrawal syndrome frequently occurs when substance use is interrupted.”¹

The Royal College of Physicians lists the following criteria for addiction:

- a strong desire to take the drug
- substance is taken in larger amounts or longer than intended
- difficulty in controlling use
- a great deal of time is spent in obtaining, using or recovering from the effects of the substance
- a higher priority is given to drug use than to other activities and obligations
- continued use despite harmful consequences
- tolerance
- withdrawal.²

Is nicotine addictive?

The 2010 US Surgeon General’s report states that “nicotine is the key chemical compound that causes and sustains the powerful addicting effects of commercial tobacco products.”³ This report followed a landmark review published in 1988 which had also concluded that cigarettes and other forms of tobacco are addictive and nicotine is the drug in tobacco that causes addiction.⁴

The Royal College of Physicians’ 2000 report on nicotine addiction states that “it is reasonable to conclude that nicotine delivered through tobacco smoke should be regarded as an addictive drug, and tobacco use as the means of self-administration” and concludes that: “Cigarettes are highly efficient nicotine delivery devices and are as addictive as drugs such as heroin or cocaine.”²

It is important to note that it is the delivery of nicotine through tobacco smoke which makes it potentially addictive as this is the fastest way of delivering nicotine to the bloodstream.⁵ Tobacco smoke may also include chemicals that make nicotine more potent because nicotine separated from tobacco is not particularly addictive. Studies have shown that animals do not self-administer nicotine readily even if provided rapidly, and nicotine replacement treatments have virtually no addictive potential for non-smokers and only limited appeal to smokers.² However, addiction is not purely a biological need for a drug as this can be controlled by

medication. In many cases, including among tobacco smokers, people repeatedly return to drug use even after withdrawal symptoms have ceased. This behaviour comes to dominate an addict's life in a way that causes significant harm. Whilst physical dependency resulting in withdrawal symptoms plays a role, it is not the only factor. Other considerations include a person's beliefs about smoking and their attachment to a 'smoker identity'.⁶

There is some evidence to suggest that smokers can become addicted to nicotine in tobacco smoke very quickly. In England, the annual survey of secondary schoolchildren has shown that regular smokers are likely to show signs of nicotine dependence. In the most recent survey, 67 per cent of 11-15 year olds smokers reported that they would find it difficult not to smoke for one week and three quarters (75 per cent) would find it difficult to give up altogether. In 2014, just over a half (51%) of regular smokers reported that they had tried to give up smoking.⁷

Harm to health from nicotine

Almost all of the harm from smoking comes from the inhalation of tobacco smoke rather than nicotine.⁵ There are some risks to health but overall they are relatively minor. Nicotine increases heart rate and blood pressure and can also increase gastric acid secretion leading to peptic ulcers.⁸

Smoking during pregnancy is associated with a number of disorders and nicotine is believed to be a factor in adversely affecting fetal brain and lung development. The extent of harm from use of nicotine from other sources, notably nicotine replacement therapy, is less clear but the evidence to date suggests that medicinal nicotine does not reduce birth weight and is not a cause of serious developmental abnormalities.⁵ In fact, the only study that compared fetal and maternal outcomes in pregnant women who used nicotine and placebo patches reported better outcomes with nicotine patches.¹⁰

Children are also at risk of nicotine poisoning through accidental ingestion of tobacco or liquid nicotine. However, serious poisoning is usually prevented by the fact that even relatively small doses cause nausea and vomiting which stops users from further intake.¹¹

Properties of nicotine

When a person smokes, nicotine is distilled from burning tobacco and small droplets of tar containing nicotine are inhaled and deposited in the lungs. Nicotine can be absorbed quickly or slowly depending on the route of administration and how the drug is formulated. During smoking, nicotine enters the bloodstream rapidly, peaking approximately 20 seconds after inhalation.⁵ By contrast, the various types of nicotine replacement therapy including electronic cigarettes deliver nicotine much more slowly.

Paradoxically, while nicotine is a stimulant drug, effects of both stimulation and relaxation may be felt. The mental and physical state of the smoker, and the situation in which smoking occurs, can influence the way in which a particular cigarette will affect psychological perceptions.⁴ The addictive effect of nicotine is linked to its capacity to trigger the release of dopamine - a chemical in the brain that is associated with feelings of pleasure.

However, when people who have never smoked are given nicotine they do not experience the mood-enhancing benefits reported by smokers, suggesting that the feelings of pleasure derived from smoking are largely due to the alleviation of cravings for nicotine after periods of abstinence.²

Difficulty in quitting

Possibly one of the strongest indicators of the effect of nicotine inhaled through tobacco smoke is the discrepancy between the desire to quit and quitting success rates. Surveys consistently

show that the majority of smokers (around two-thirds) want to stop smoking¹² yet the successful quit rate remains very low.

The 2008/09 “Smoking-related Behaviour and Attitudes” survey found that 26% of smokers had attempted to quit in the previous year and as many as 21% of smokers had made three attempts in the previous year alone.¹³ However, only eight per cent of smokers succeeded in quitting for two or more years. Data from the English Smoking Toolkit Study shows that in 2015, 6.2% of smokers reported having stopped smoking during the previous 12 months while 32.5% had attempted to do so.¹⁴ Most smokers take several attempts to quit before they finally succeed.¹⁵

The power of addiction is further demonstrated by the fact that some smokers are unable to stop smoking even after undergoing surgery for smoking-related illnesses. One study found that around forty per cent of those who had a laryngectomy resumed smoking soon after surgery, while about 50 per cent of lung cancer patients resumed smoking after undergoing surgery.¹⁶ Among smokers who have had a heart attack, as many as 70% take up smoking again within a year.¹⁷ More recent studies confirm the difficulties faced by smokers in quitting even following the diagnosis of a life threatening illness.^{18 19}

Other measures of dependence

A widely used tool for measuring nicotine addiction is the Fagerström test for nicotine dependence.²⁰ The questionnaire determines the degree of dependence by measuring the extent of nicotine exposure, impaired control over use and urgency for use. A key question about time from waking to first cigarette can predict how difficult quitting smoking is likely to be. In 2015, a YouGov survey commissioned by ASH found that among smokers of all ages, 56% reported lighting up within half an hour of waking including 18% who had their first cigarette of the day within five minutes of waking.²¹

Nicotine withdrawal symptoms

Another marker for addiction is the occurrence of withdrawal symptoms following cessation of drug use. For smokers, typical physical symptoms following cessation or reduction of smoking include urge to smoke, irritability, anxiety, difficulty concentrating, restlessness, sleep disturbances, decreased heart rate, and increased appetite or weight gain.²² These symptoms can be alleviated by using Nicotine Replacement Therapy products or other medication such as varenicline (Champix) or bupropion (Zyban).

Genetic influence

An individual’s likelihood of becoming addicted to nicotine may be influenced by their genetic make-up. Twin and family studies have shown that there is not one specific gene that determines who will develop a smoking addiction but rather several genes that cause an individual to become more susceptible to being addicted to smoking.²³ These genes are responsible for how certain neurotransmitters are produced and metabolised, the number of receptors that are available to act on and how rapidly nicotine is metabolised by the individual. A New Zealand longitudinal study measuring smoking initiation, conversion to daily smoking, nicotine dependence and cessation difficulties found that the genetic risk score was unrelated to smoking initiation. However, individuals at higher genetic risk were more likely to become daily smokers as teenagers, progressed more rapidly to heavy smoking, developed nicotine dependence more frequently and were more likely to fail in their cessation attempts.²⁴

Nicotine and harm reduction

Although nicotine is the addictive component of tobacco products it is the toxins and carcinogens in tobacco smoke that cause most of the harm from using tobacco.⁵ Nicotine extracted from tobacco can be used to help people overcome their compulsion to smoke as

demonstrated through the use of nicotine replacement therapies (NRT) and consumer nicotine products including electronic cigarettes.

Nicotine Replacement Therapy

Nicotine Replacement Therapy (NRT) works by providing smokers with nicotine to help them deal with withdrawal symptoms after quitting smoking. NRT is much safer than smoking because it does not contain the tar and other toxic chemicals contained in tobacco smoke. NRT is available in many forms including chewing gum, lozenges, patches, inhalers and a nasal spray.²⁵ Using NRT can roughly double a person's chances of successfully stopping smoking compared to someone trying to quit unaided.⁶ For more information about using nicotine as an aid to stopping smoking see the ASH fact sheet: [Stopping smoking - the benefits and aids to quitting.](#)

Non medicinal nicotine products

Aside from medicinal NRT, currently the main alternative source of nicotine available to consumers is from electronic cigarettes, also known as vapourisers. These devices have risen in popularity in recent years and are used by smokers and ex-smokers to cut down, quit or prevent relapse to smoking.²⁶ Electronic cigarettes act in a similar way to other forms of nicotine replacement therapy. For further information on tobacco harm reduction and e-cigarettes see: <http://ash.org.uk/current-policy-issues/harm-reduction-product-regulation/regulating-nicotine-products>

Tobacco industry recognition of the importance of nicotine

Tobacco industry documents dating from the 1960s have shown that tobacco companies recognised that the main reason that people continue smoking is nicotine addiction. A lawyer acting for Brown & Williamson said: "*Nicotine is addictive. We are, then, in the business of selling nicotine, an addictive drug.*"²⁷ Publicly, however, tobacco companies denied that nicotine was addictive, because such an admission would have undermined their stance that smoking is a matter of personal choice. As the US Tobacco Institute put it in 1980: "*We can't defend continued smoking as 'free choice' if the person was 'addicted'.*"²⁸ The industry was also quick to realise that selling an addictive product is good for business: as a British American Tobacco memo said in 1979: "*We also think that consideration should be given to the hypothesis that the high profits additionally associated with the tobacco industry are directly related to the fact that the customer is dependent on the product.*"²⁹ In March 1997, Liggett Group, the smallest of the five major US tobacco companies, became the first to admit that smoking is addictive as part of a deal to settle legal claims against the company.³⁰ Subsequently the tobacco companies tried to cast doubt over the meaning of addiction by comparing smoking with other common pursuits such as shopping or eating chocolate.³¹

For further examples of the tobacco industry's position on addiction see [chapter 2](#) of 'Tobacco Explained'. Other examples can be found in "[Trust Us, We're the Tobacco Industry](#)".

References

- 1 World Health Organization website. Programmes and Projects, Management of Substance Abuse. [Lexicon of alcohol and drug terms published by the World Health Organization.](#)
- 2 [Nicotine Addiction in Britain.](#) A report of the Tobacco Advisory Group of the Royal College of Physicians. London, RCP, 2000.
- 3 [How tobacco smoke causes disease: the biology and behavioral basis for smoking-attributable disease.](#) A report of the Surgeon General. US Department of Health and Human Services. 2010.
- 4 [The health consequences of smoking. Nicotine Addiction.](#) A report of the Surgeon General. US DHHS, 1988.
- 5 [Harm reduction in nicotine addiction. Helping people who can't quit.](#) A report by the Tobacco Advisory

- group of the Royal College of Physicians. London, RCP, 2007
- 6 West R & Shiffman S. Fast Facts: Smoking cessation. London, Health Press, 2007.
- 7 [Smoking, drinking and drug use among young people in England in 2014](#). Health and Social Care Information Centre, 2015.
- 8 Haustein K-O. Tobacco or health? Physiological and social damages caused by tobacco smoking. Berlin, Springer-Verlag, 2003
- 9 [The health consequences of smoking. Fifty years of progress](#). A report of the Surgeon General. US DHSS, 2014
- 10 Cooper, S et al. [Effect of nicotine patches in pregnancy on infant and maternal outcomes at 2 years: follow-up from the randomised, double-blind, placebo-controlled SNAP trial](#). Lancet Respir Med. 2014 Sep;2(9):728-37. Epub 2014 Aug 10. <http://www.ncbi.nlm.nih.gov/pubmed/25127405>
- 11 McNeill A et al. [E-cigarettes: an evidence update](#). London, Public Health England, 2015
- 12 [General Lifestyle Survey, 2010](#) Office for National Statistics, 2012
- 13 Lader D. [Opinions Survey Report No. 40 - Smoking-related behaviour and attitudes. 2008/09](#) Office for National Statistics
- 14 [Smoking Toolkit Study](#). Topline findings, Dec. 2015 <http://www.smokinginengland.info/latest-statistics/>
- 15 Benowitz NL. [Nicotine Addiction](#). New England Journal of Medicine 2010; 362 (24): 2295–2303. doi: 10.1056/NEJMra0809890
- 16 Stolerman IP, Jarvis MJ. [The scientific case that nicotine is addictive](#). Psychopharmacology 1995; 117: 2-10.
- 17 Stapleton J. [Cigarette smoking prevalence, cessation and relapse](#). Stat Meth Med Res 1998; 7:187-203
- 18 Cooley ME, Sarna L, Kotlerman J et al. [Smoking cessation is challenging even for patients recovering from lung cancer surgery with curative intent](#). Lung Cancer 2009; 66 (2): 218-225
- 19 Zmeskal M et al. [Continued smoking in lung transplant patients: A cross sectional survey](#). Slovenian J Pub Health 2016; 55(1) 29-35
- 20 Fagerstrom K-O, Schneider NG. [Measuring nicotine dependence: a review of the Fagerstrom Tolerance Questionnaire](#). Journal of Behaviour Medicine 1989; 12 (2): 159-182
- 21 YouGov plc. Total sample size was 12,055. Fieldwork was undertaken between 26th February and 12th March 2015. All surveys were carried out online. The figures have been weighted and are representative of all GB Adults (aged 18+).
- 22 Department of Health website. Smokefree NHS. [Advice and Information/ FAQs](#)
- 23 Davies GE, Soundy TJ. [The genetics of smoking and nicotine addiction](#). South Dakota Medicine. 2009; Spec No:43-9.
- 24 Belsky DW et al. Polygenic risk and the developmental progression to heavy, persistent smoking and nicotine dependence. Evidence from a 4-decade longitudinal study. JAMA Psychiatry 2013; 70(5): 534-542
- 25 [Nicotine Replacement Therapy](#). Patient website.
- 26 [ASH fact sheet: Use of electronic cigarettes among adults in Great Britain](#). May 2015
- 27 Yeaman, A. Brown & Williamson memo 1802.05, 17 July 63.
- 28 Tobacco Institute. Minnesota trial exhibit 14,303. 9 September 1980
- 29 BAT. Key areas for product innovation over the next ten years. Minnesota Trial Exhibit 11, 283.
- 30 Osborne, D. Smoking kills: tobacco firm. The Independent, 21 March 1998.
- 31 Proctor, C. BAT Industries - Smoking gun? The Observer, 1 March 1998.