

BACKGROUND BRIEF

Further Information

What's in cigarettes

Cigarette smoke is a complex mixture of over 4000 chemicals.¹ These chemicals are present as:

- gases, such as carbon monoxide, hydrogen cyanide, nitrogen oxides,
- liquid vapours, such as formaldehyde, methane, benzene, ammonia, acetone,
- part of tiny solid particles, such as phenols, nicotine, and naphthalene.^{1,2}

Thirty metals have been detected in tobacco smoke, as well as radioactive compounds such as polonium 210 and potassium 40.^{1,3}

Many of the chemicals in cigarette smoke come from burning tobacco; the remainder come from burning cigarette paper, agricultural chemicals left on the tobacco leaves, and chemicals added during the cigarette making process.^{1,3}

Once inhaled into the lungs, many of these chemicals pass through the lungs walls into the blood stream, and are pumped around the body.²

Tar, nicotine and carbon monoxide contribute to most smoking related diseases.^{2,4} However, there are many other chemicals in tobacco smoke which also have a role in causing disease.²

Tar

'Tar' describes the solid particles inhaled when a smoker draws on a lit cigarette.⁴ Each particle consists of a large variety of organic and inorganic chemicals, including a number of carcinogens (cancer causing substances).^{1,4} Tar can vary between the smoke from different types of cigarettes: it may contain different ratios of carcinogens and other substances.^{5,6} Tar is the sticky brown substance which can stain smokers' fingers and teeth yellow-brown. It also stains the lung tissue.⁴

Nicotine

Nicotine is the drug in tobacco which causes addiction in smokers.⁷ It is a highly toxic chemical and its manufacture, use and sale is controlled under the State Poisons Acts, except where it occurs in tobacco.^{7,8,9} This exception of tobacco is for political reasons, not because nicotine is deemed 'safe' in cigarettes.⁵

Nicotine, once inhaled, affects the body very quickly. Within seconds, nicotine reaches the brain releasing dopamine, a 'brain reward' chemical.¹⁰ It causes changes to the structure and the working of the brain, which lead to, and maintain, nicotine addiction.^{2,10} Nicotine also raises heart rate, blood pressure, releases hormones affecting the central nervous system, and constricts small blood vessels under the skin.⁷ In the long term, nicotine may be a factor in causing coronary disease. It is believed to be involved in the development of gastrointestinal disorders and problems during pregnancy, and is linked with the development of cancers.⁷

Nicotine replacement products, used as quitting aids, are regulated. These safer forms of nicotine products, that is, nicotine gum, patches, lozenges and inhalers, are sold by pharmacies.⁸

Carbon monoxide

Carbon monoxide is a poisonous gas which competes with oxygen in the blood.² This is the same gas which is found in car exhaust fumes. Carbon monoxide binds to red blood cells, making it harder for the body to carry oxygen to the muscles.¹¹ In large quantities, carbon monoxide is rapidly fatal. Smokers can have up to 10 times the amount of carbon monoxide in their bloodstream than non-smokers.^{1,12}

Chemicals in cigarettes and disease

Cigarette smoke has many different effects on health. It causes or is associated with over thirty different diseases, including cancer, emphysema, heart disease and stroke.¹³ A single disease may be caused by several different chemicals in cigarette smoke.²

Cancer

More than 60 carcinogens (cancer causing substances) have been identified in tobacco smoke.⁶ Smoking causes cancer of the lung, throat, voice box, mouth, lip, tongue, nose, nasal sinus, oesophagus, pancreas, bladder, stomach, liver, kidney, ureter, cervix, and bone marrow.^{1,14} Research shows that the greater the number of cigarettes and years a person smokes, the higher the risk of developing a smoking related cancer.^{1,14} Carcinogens in tobacco smoke include poly aromatic hydrocarbons, N-nitrosamines, benzene, aldehydes, the metals nickel, arsenic, chromium and cadmium, and many more.^{2,3}

Lung disease (other than cancer)

Hydrogen cyanide, acetaldehyde and acrolein directly damage cilia, the tiny hairs that have an important part in clearing the lungs of inhaled particles and substances.^{1,2,3} When this cleaning system is impaired, toxic agents can build up in the lungs, and increase the likelihood of developing lung diseases.¹⁵

Other chemicals damage the lung by increasing the amount of mucus in the lungs which can lead to infection (chronic bronchitis), airway thickening and narrowing, and permanently damaging air sacs (emphysema). These include hydrocarbons, ketones, organic acids, phenols, nitrous oxides, and oxidising agents.²

Heart disease, stroke and diseases of the veins

Acting together, nicotine and carbon monoxide are believed to cause these diseases in smokers, by damaging blood vessel walls and reducing the supply of oxygen to the body.^{2,7} Cigarette smoke also contains poly aromatic hydrocarbons which speed up the build up of fatty material on blood vessel walls, and are possibly assisted by hydrogen cyanide, nitrous oxides and some chemicals in tar. Highly reactive chemicals in smoke (free radicals) can damage the heart muscles.²

Agricultural chemicals and additives

In Australia, tobacco is not classified as a food or a drug,^{9,16} and so there are no standards or controls on what may be used or left on tobacco, including agricultural chemicals and additives.¹⁷

Herbicides, insecticides, fungicides, fertilisers and other agricultural chemicals are routinely used in tobacco growing.^{3,17} As Australia imports much of its tobacco,¹⁸ it is unknown which agricultural chemicals may be present in cigarettes made and sold here.

Additives are chemicals added to cigarettes in the manufacturing process.^{2,3} They serve a number of different purposes.

- To add flavour. Flavourings include sugar, honey, liquorice, cocoa, and chocolate liquor. These sweeteners lessen the harshness of the smoke.¹⁹
- To lessen the irritating effects of smoke. Menthol and eugenol numb the throat.¹⁹
- To change the chemistry of nicotine. Ammonium salts and acetaldehyde (in burnt sugar) increase nicotine's addictive potential.^{2,19}
- To change smoker's bodies. Chemicals in liquorice and cocoa act to open the airways, so that more nicotine and tar goes deeper into smokers' lungs. Other additives change the chemistry of smokers' brains to make them more receptive to nicotine.¹⁹
- To mask the smell and visibility of smoke from the end of a burning cigarette. This might reduce other people's annoyance, but it doesn't reduce the health risks of passive smoking.^{19,20}
- To keep the tobacco moist, to control the burn temperature, and to treat the cigarette paper.^{3,17}

There are a number of problems with additives.

- Additives such as sugar and honey might seem harmless because we are used to eating them. But when additives in cigarettes are burnt, they can change into different chemicals, and some are toxic. For example, liquorice and sugar produce cancer causing chemicals when burnt. Also, these substances are inhaled into the lungs, which are delicate and much more vulnerable to harm than the stomach and intestines.¹⁹
- The health effects of additives on smokers are not made public by the tobacco companies, and many may not be known at all.¹⁹
- Some additives make tobacco smoke less harsh and taste better. It may make it easier for children to learn to smoke, and make smoking more agreeable to smokers.¹⁹

Cigarettes that claim to have no additives are not necessarily safer than those that have them. The cigarette smoke will still contain agricultural chemicals, nicotine, carbon monoxide, cancer causing tar, and more.¹

Disclosure of additives

In Australia, there are no regulations to require tobacco companies to make public what they add to their cigarettes. The tobacco companies currently have a Voluntary Agreement with the Australian Department of Health and Ageing, where they provide a list of additives for each brand. However the terms of this agreement protects “the confidentiality of tobacco manufacturers’ trade secrets”: they can choose not to list specific additives they do not wish to make public. This agreement expires on 21 December 2003.²¹

Other countries such as Canada, New Zealand and the state of Massachusetts USA, have regulations requiring companies to inform the governments of all additives they use.^{22, 23, 24}

How much do smokers inhale?

Package labelling information

The yields of tar, nicotine and carbon monoxide are supplied by the tobacco industry, and appear on the side of all cigarette packs sold in Australia. These yields are obtained using a machine, which extracts a certain amount of smoke from a cigarette (according to the U.S. Federal Trade Commission (FTC) method).²

The concentrations of the yields in machine extracted smoke usually range between 1mg – 16mg tar, 0.1mg— 1.5mg nicotine, and 1mg— 15mg carbon monoxide.

However, smokers can inhale very different amounts of smoke compared to the machine.² There is no ‘set’ amount of nicotine, tar and other chemicals delivered by any cigarette to a smoker. Different smokers can inhale and absorb very different amounts of chemicals from a similar cigarette, including high amounts from a ‘low tar’ cigarette.²

The myth of low tar cigarettes

Addiction to nicotine is a major reason for remaining a smoker.⁷ In general, smokers will absorb between 0.2mg to 2mg of nicotine per cigarette: the average dose is about 1mg per cigarette.² Most cigarettes are designed by tobacco companies to deliver as much nicotine as the smoker needs to maintain their addiction, regardless whether the cigarette is deemed to be 'low tar' or 'regular'.

The design of 'low tar / low nicotine' cigarettes

Cigarettes with low machine yields of tar usually have low nicotine as well. This is because one of the main ways to reduce the machine yields is to dilute the cigarette smoke with air, by putting air vent holes in the filter.^{2, 6} In a study testing 92 brands of cigarettes, most had air vents. Tests on 'low tar' brands (1mg, 2mg, 3mg of tar) found that 60% to 85% of machine extracted 'smoke' was made up of air sucked in via the vents.²⁵

Smoking behaviour and chemical intake

In order to get the nicotine they need, smokers who switch to 'lower tar/nicotine' cigarettes may increase the amount of smoke they inhale by doing the following:

1. Smokers learn to compensate by taking larger and longer puffs, and by taking more puffs from a cigarette, than the FTC (machine) method. More intensive smoking also increases the ratio of tar to nicotine.⁶
2. Smokers can easily block the air vent holes in the filter, usually by accident with their lips and fingers, and so they receive more smoke and less air.⁶ In a sample of 13 Australian low tar cigarettes tested in 1992, there was a 2 to 9 fold rise in tar and nicotine when all the air holes were blocked.²⁶
3. Some smokers will smoke more cigarettes per day.⁶

Health risks of 'low tar' cigarettes

There is no evidence that smokers of 'low tar' cigarettes have less risk of smoking related diseases than smokers of other cigarettes, except possibly a small decrease in risk for lung cancer.⁶

Some countries, such as those in the European Union, have banned the use of terms such as 'low-tar', 'light', 'ultralight', names, pictures and other signs on cigarette packets, which may mislead consumers into thinking they are less harmful.²⁷

In summary, there is no safe cigarette and no safe level of consumption.⁴

Useful Websites:

- Physicians for a Smoke-free Canada. Chemicals in cigarette smoke. <http://www.smoke-free.ca/factsheets/Chemicals.htm>, accessed 6 May, 2003.
- Australian Department of Health and Ageing. Australian Cigarette Ingredient Information. Voluntary Agreement for the disclosure of the ingredients of cigarettes. <http://www.health.gov.au/pubhlth/strateg/drugs/tobacco/ingredients.htm>, accessed 6 May, 2003.
- U.S. Department of Health and Human Services. Risks associated with smoking cigarettes with low machine-measured yields of tar and nicotine. (Smoking and Tobacco Control Monograph 13) <http://cancercontrol.cancer.gov/tcrb/monographs/13/>, accessed 22 May, 2003.
- Action on Smoking and Health. Bates C, Jarvis M, Connolly G. Tobacco Additives: cigarette engineering and nicotine addiction. <http://www.ash.org.uk/html/regulation/html/additives.html>, accessed 27 May, 2003.

References:

- 1 US Department of Health and Human Services. *Reducing the Health Consequences of Smoking: 25 Years of Progress. A Report of the US Surgeon General*. Rockville, Maryland: US Department of Health and Human Services, Office on Smoking and Health, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, 1989. <http://profiles.nlm.nih.gov/NN/B/B/X/S/>, accessed 22 May, 2003.
- 2 U.S. Department of Health and Human Services. *The FTC cigarette test method for determining tar, nicotine and carbon monoxide yields of U.S. cigarettes. Report of the NCI Expert Committee*. (Smoking and Tobacco Control Monograph 7) Bethesda, MA: U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, 1996. NIH Publication No. 96-4028.
- 3 International Agency for Research on Cancer. *Tobacco smoking. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans*. Volume 38. World Health Organization, 1985.
- 4 US Department of Health and Human Services. *The Health Consequences of Smoking: The Changing Cigarette. A report of the US Surgeon General*. Rockville, Maryland: US Department of Health and Human Services, Public Health Service, Office on Smoking and Health, 1981.
- 5 Gray N. Reflections on the saga of tar content: why did we measure the wrong thing? *Tob Control* 2000;**9**(1):90-4.
- 6 U.S. Department of Health and Human Services. *Risks associated with smoking cigarettes with low machine-measured yields of tar and nicotine. (Smoking and Tobacco Control Monograph 13)* Bethesda, MA: U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, 2001. NIH Publication No. 02-5074. <http://cancercontrol.cancer.gov/tcrb/monographs/13/>, accessed 22 May, 2003.
- 7 US Department of Health and Human Services. *The Health Consequences of Smoking: Nicotine Addiction. A report of the US Surgeon General*. Rockville, Maryland, US Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Health Promotion and Education, Office on Smoking Health, 1988.
- 8 National Drugs and Poisons Schedule Committee. *Standard for the Uniform Scheduling of Drugs and Poisons No. 17 Amendment No. 1*. Canberra: Commonwealth Department of Health and Ageing, 2002.
- 9 Commonwealth Department of Health. *Tobacco is specifically exempted from the Uniform Poisons Schedule, Standard as adopted by the National Health and Medical Research Council*, 94th Session. October 1982.
- 10 Royal College of Physicians of London. *Nicotine addiction in Britain. A report of the Tobacco Advisory group of The Royal College of Physicians*. London: Royal College of Physicians of London, 2000.
- 11 US Department of Health and Human Services. *The Health Consequences of Smoking: Cardiovascular Disease. A Report of the US Surgeon General*. Rockville, Maryland: US Department of Health and Human Services, Office on Smoking and Health, Public Health Service, Department of Health Education and Welfare, 1983.
- 12 Rodrigo C. The effects of cigarette smoking on anesthesia. *Anesth Prog*. 2000 Winter;**47**(4):143-50. Review.
- 13 Ridolfo B, Stevenson C. *The quantification of drug-caused mortality and morbidity in Australia, 1998*. (Drug Statistics Series No. 7) Canberra: Australian Institute of Health and Welfare, 2001.
- 14 International Agency for Research on Cancer. *Tobacco smoking and Tobacco Smoke. Summary of Data Reported and Evaluation. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*. World Health Organization, 2002. Available at <http://monographs.iarc.fr/htdocs/monographs/vol83/01-smoking.html>, accessed 11 February, 2003.
- 15 US Department of Health, Education and Welfare. *Smoking and Health: A report of the US Surgeon General*. Rockville, Maryland, US Department of Health, Education and Welfare, Public Health Service, Office of the Assistant Secretary for Health, Office on Smoking and Health, 1979.
- 16 Standing Committee on Agriculture - Technical Committee on Agricultural Chemicals. *Protocol of requirements for chemicals used on tobacco*. Canberra, ACT: Department of Primary Industry, March 1985. (Document PB 479.)
- 17 Chapman S. Come to where the flavour is: additives and pesticide residue in cigarettes. *Drug and Alcohol Review* 1992; **11**: 3-6.

- 18 Tobacco Research & Development Corporation. *Annual report 2001/02*. Jamison Centre, ACT: Tobacco Research and Development Corporation, 2002.
- 19 Bates C, Jarvis M, Connolly G. *Tobacco Additives: cigarette engineering and nicotine addiction*. London: Action on Smoking and Health, 1999. <http://www.ash.org.uk/html/regulation/html/additives.html>, accessed 27 May, 2003.
- 20 Connolly GN, Wayne GD, Lymperis D, Doherty MC. How cigarette additives are used to mask environmental tobacco smoke. *Tob Control* 2000; **9**: 283–291.
- 21 Australian Department of Health and Ageing. *Australian Cigarette Ingredient Information. Voluntary Agreement for the disclosure of the ingredients of cigarettes*. <http://www.health.gov.au/pubhlth/strateg/drugs/tobacco/ingredients.htm>, accessed 6 May, 2003.
- 22 Health Canada. *Tobacco Reporting Regulations*. June 2000. http://www.hc-sc.gc.ca/hecs-sesc/tobacco/legislation/prop_may_36b.html, accessed 6 May, 2003.
- 23 Ministry of Health, New Zealand. *National Drug Policy Website. Tobacco Control Legislation*. (Smokefree Environments Act 1990, Sect.3³5.) <http://www.ndp.govt.nz/>, accessed 6 May, 2003.
- 24 The General Court of the Commonwealth of Massachusetts. *Massachusetts General Laws, Chapter 94, INSPECTION AND SALE OF FOOD, DRUGS AND VARIOUS ARTICLES. Section 307B. Tobacco products; annual reports of added constituent and nicotine yield ratings*. <http://www.state.ma.us/legis/laws/mgl/94%2D307b.htm>, accessed 6 May, 2003.
- 25 Kozlowski LT, Mehta NY, Sweeney CT, Schwartz SS, Vogler GP, Jarvis MJ, West RJ. Filter ventilation and nicotine content of tobacco in cigarettes from Canada, the United Kingdom, and the United States. *Tob Control*. 1998 Winter; **7(4)**:369–75.
- 26 Evans GS. *A study of smoke yield of vented filter cigarettes*. South Melbourne, Vic: Australian Government Analytical Laboratories, 1993.
- 27 European Union. The European Parliament. The Council. *Directive of the European Parliament and of the Council on the approximation of the laws, regulation and administrative provisions of the Member States concerning the manufacture, presentation and sale of tobacco products. Joint text approved by the Conciliation Committee provided for in Article 251(4) of the EC Treaty*. 1999/0244(COD) C5–0086/2001. <http://www.ash.org.uk/html/regulation/pdfs/conciliationtext.pdf>, accessed 22 May, 2003.